

RULES
AND
REGULATIONS

1947-48

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Lloyd's Register of Shipping.

RULES AND REGULATIONS

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LLOYD'S REGISTER OF SHIPPING, issued annually in July. This Book contains the Names, CLASSES, and detailed information concerning the Vessels classed by Lloyd's Register and the late Underwriters' Registry for Iron Vessels; particulars, as far as possible, of ALL SEA-GOING MERCHANT VESSELS in the World, and of all iron and steel vessels trading on the North American Lakes, of 100 tons and upwards, together with particulars of vessels fitted with Refrigerating Appliances, and a list of Owners and Managers of Ships recorded in the Register Book.

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Lloyd's Register of Shipping.

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RE-CONSTITUTED 1834.

UNITED WITH THE
UNDERWRITERS' REGISTRY FOR IRON VESSELS IN 1885

RULES AND REGULATIONS

FOR THE

CONSTRUCTION AND CLASSIFICATION OF STEEL VESSELS

71, FENCHURCH STREET, LONDON, E.C.3

1947

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Telegrams: Surveyor, Helsingfors.
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Telegrams: Register, Aruba.

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Telegrams: Lloyd, Halifax, N.S.

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Office: Kings Wharf Building, St. John's.
Telephone No. 1697M. Telegrams: Surveyor.

Ship and Engineer Surveyor ... R. A. Harvey

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Telephone No. 2930.
Telegrams: Edwat, Jamaica.

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Telegrams: Cubitt, care Huggins & Co., Port of Spain.

Ship and Engineer Surveyor ... *J. C. Cubitt

CUBA.

HAVANA.

Office: San Pedro 16, Apartado 843, Havana.
Telephone No. M.-6908.
Telegrams: Tomholmes, Havana.

Ship and Engineer Surveyor ... *T. F. Holmes

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Telephone No. Central 686, Georgetown.
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Ship and Engineer Surveyor ... *B. L. Greathead

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Telephone No. Norte 23.2523.
Telegrams: Surveyor, Rio de Janeiro.

Ship and Engineer Surveyor ... M. Caldwell

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Telephone No. 4604.
Telegrams: Airdrie.

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Ship and Engineer Surveyor ... J. de Wolf

NORTH AFRICA.
ALGERIA AND TUNISIA.

ALGIERS.

Office: 19, Boulevard Carnot, Algiers.
Telephone No. 325-22 and 735-44.
Telegrams: Vandam, c/o Amas.

Ship and Engineer Surveyor ... *R. J. van Dam

NIGERIA.

LAGOS.

Office: Kakawa House, Kakawa Street, Lagos.
Telephone: Telegrams: Lloydsreg, Lagos.

Ship and Engineer Surveyor to Lloyd's Register and British Corporation ... ... D. Ross Innes

*Not an Exclusive Officer of Lloyd's Register.

SURVEYORS—PORTS ABROAD—*continued.*

SOUTH AND EAST AFRICA.

Principal Surveyor for South and East Africa ... ... A. H. Boyle, D.S.C. (at Cape Town)

CAPE TOWN.

Office: 104, Commonwealth Building, Adderley Street, Cape Town.
Telephone No. 2-4493.
Telegrams: Lloydsreg.

Ship and Engineer Surveyor ... A. H. Boyle, D.S.C. (*Principal Surveyor for South and East Africa*)

Engineer Surveyor ... ... J. Howarth

PORT ELIZABETH.

Office: 6, Villiers Road, Walmer, Port Elizabeth.
Telegrams: Donkin, Humewood, Port Elizabeth.

Ship and Engineer Surveyor ... *A. Donkin

PORT NATAL.

Office: 23/24, Cato House, 340, Smith Street, Durban; P.O. Box 170.
Telephone No. 24092.
Telegrams: Lloydsreg, Durban.

Ship and Engineer Surveyors ... P. F. Balfour
J. A. van Lare

ASIA.

ADEN.

ADEN (*See under* EGYPT AND RED SEA).

CHINA.

SHANGHAI, *including Woosung, Chinkiang and Nanking.*

Office: Jardines Building, 27, The Bund, Shanghai.
Telegrams: Register.
Telephone No. 15874.

Ship and Engineer Surveyor ... C. Ritchie

TIENTSIN.

Office: 151, Chang Cheng Lu, Tientsin.
Telegrams: Seaworthy.

Ship and Engineer Surveyor ... *R. G. Lapper

EAST INDIAN ARCHIPELAGO.

BATAVIA.

Office: c/o Hotel de Nederlanden, Rijswijk, Batavia-Centrum.

Ship and Engineer Surveyor ... J. F. Vrouwes

MACASSAR.

Ship and Engineer Surveyor ... *T. R. van Dam

MANILA, P.I., *and ports in the Philippine Islands.*

Office: 240, Dasmarinas, Manila.
Telephone No. 2-17-13.
Telegrams: Register.

Ship and Engineer Surveyor ... *C. B. Nelson

SOURABAYA.

Office: Marine Etablissement, Sourabaya, Java.

Ship and Engineer Surveyor ... *Eng.-Comdr. C. van der Linden

HONG KONG.

HONG KONG.

Office: Shell House, Queen's Road, Hong Kong.
Telephone:
Telegrams: Marine.

Ship and Engineer Surveyors ... J. A. Anderson
F. B. Gill

INDIA, PAKISTAN, CEYLON, BURMA, SIAM, COCHIN-CHINA AND STRAITS SETTLEMENTS.

BANGKOK.

Office: c/o Borneo Co., Ld., Bangkok.

Ship and Engineer Surveyor ... *N. A. Richardson

BOMBAY.

Office: Laxmi Building, Ballard Road, Bombay.
Telephone No. 23335. Telegrams: Surveyor.

Ship and Engineer Surveyors ... J. Rundle
R. Rodger
T. H. Noel

CALCUTTA.

Office: 9, Netaji Subhas Road, Calcutta.
Telephone No. 1182. Telegrams: Freeboards.

Ship and Engineer Surveyors ... R. Shaw
C. S. Newton

COLOMBO.

Office: 19½, P.O. & B.I. Building, York Street, Colombo.
Telephone No. 3694. Telegrams: Register.

Ship and Engineer Surveyor ... F. E. Turpie

KARACHI.

Office: c/o Messrs. G. B. Potts & Co., Mercantile Bank Building, McLeod Road, Karachi.
Telephone: Karachi 2433.
Telegrams: Freeboard, Karachi.

Ship and Engineer Surveyor ... *J. Johnston

MADRAS.

Office: c/o Port Trust, Madras, S. India.
Telephone: 2965 Office, 3461 Residence.
Telegrams: White, Port Trust, Madras.

Ship and Engineer Surveyor ... *S. W. White

RANGOON.

Office: c/o Port Commissioners, Rangoon.

Ship and Engineer Surveyor ... *R. P. R. Taylor

SINGAPORE.

Office: 2, Laidlaw Building, Battery Road, P.O. Box 480, Singapore.
Telephone: 2861.
Telegrams: Surveyor.

Ship and Engineer Surveyor ... J. Wormald, B.Sc.

VIZAGAPATAM.

Office: P.O. Box 109, Vizagapatam Port, Vizagapatam, S. India.
Telegrams: Surveyor, Vizagapatam.

Ship Surveyor ... ... R. H. T. Gordon

*Not an Exclusive Officer of Lloyd's Register.

SURVEYORS—PORTS ABROAD—*continued*.

AUSTRALIA AND NEW ZEALAND.

PRINCIPAL SURVEYOR FOR AUSTRALIA AND NEW ZEALAND ... ... H. A. Garnett
(at Sydney)

ADELAIDE, S.A.

Office: Institute Chambers, Divett Street, Port Adelaide.
Telephone No. Y.1547.
Telegrams: Dinwoodie.

Ship and Engineer Surveyor ... *C. E. Hall

AUCKLAND, N.Z.

Office: 63, Endeans Buildings, Queen Street, Auckland.
Telephone No. 43-163.
Telegrams: Somisto.

Ship and Engineer Surveyor ... *W. Richard Smith

BRISBANE (Queensland).

Office: Orient Line Building, Eagle Street, Brisbane.
Telephone No. 4189.
Telegrams: Register.

Ship and Engineer Surveyor ... J. E. North

CHRISTCHURCH & LYTTELTON, N.Z.

Office: Civic Chambers, 213, Manchester Street, P.O. Box 1171, Christchurch.
Telephone No. 37-527 (Office), 30-063 (Residence).
Telegrams: Oileng.

Ship and Engineer Surveyor ... *E. P. Combellack

DUNEDIN, N.Z.

Office: Colonial Mutual Assurance Buildings, 276, Princes Street, Dunedin, C.I. P.O. Box 904.
Telephone No. 10-672.
Telegrams: Cellular.

Ship and Engineer Surveyor ... *G. W. Martin

FREMANTLE, W.A.

Office: 21, Phillimore Street, Fremantle, P.O. Box 16.
Telephone No. 2699.
Telegrams: Mardav.

Ship and Engineer Surveyor ... *W. G. Davies

LYTTELTON, N.Z. (*see* CHRISTCHURCH, N.Z.).

MELBOURNE (Victoria).

Office: New Zealand Chambers, 483, Collins Street, Melbourne.
Telephone No. M.U.2486.
Telegrams: Reports.

Ship and Engineer Surveyor ... P. A. McIntyre
Engineer Surveyors ... ... J. H. Cowell
J. E. Thompson

NEWCASTLE, N.S.W.

Office: T. & G. Building, Newcastle, N.S.W.; P.O. Box 64.
Telephone No. 1189 Newcastle.
Telegrams:

Ship and Engineer Surveyor ... *E. M. Hughes

SYDNEY, N.S.W.

Office: 4, Bridge Street, Sydney.
Telephone No. B.W.7023-Automatic.
Telegrams: Miramar.

Ship and Engineer Surveyors ... H. A. Garnett
Principal Surveyor for Australia and New Zealand.
B. P. Fielden
Engineer Surveyors ... ... W. B. C. Elder
A. McBurney
F. K. L. Birk
H. Gerrard

WELLINGTON, N.Z.

Office: Nathans Buildings, Wellington; G.P.O. Box 996.
Telephone No. 43-624.
Telegrams: Lloydsreg, Wellington.

Ship and Engineer Surveyor ... J. Davidson

WHYALLA.

Office: c/o Shipyard, The Broken Hill Proprietary Co., Ld., Whyalla.

Ship Surveyors ... ... T. Pratt
W. C. Millar, B.Sc.

*Not an Exclusive Officer of Lloyd's Register.

RULES AND REGULATIONS

RELATING TO THE

ADMINISTRATION OF THE SOCIETY,

TERMS OF SUBSCRIPTION TO THE REGISTER BOOK,

DUTIES OF SURVEYORS, &c.

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LLOYD'S REGISTER OF SHIPPING.

RULES AND REGULATIONS.

Section 1. THIS Society, founded in 1760 and reconstituted in 1834, was established for the purpose of obtaining for the use of Merchants, Ship Owners, and Underwriters, a faithful and accurate Classification of Mercantile Shipping, and for the government of which the following Rules and Regulations have been from time to time adopted.

Section 2. A Register Book to be printed annually for the use of Subscribers, containing the names of the Ships with other useful information, and the Character assigned, where the vessels are classed by the Society; also the names, &c., of all Ships of 100 tons and upwards unclassed by this Society.

Section 3. Each person subscribing the sum of Twelve Guineas per annum (or such other sum as the General Committee may fix) to be considered a Member of the Society, and entitled *for his own use* to one copy of the Register Book.

Section 4. The Subscription of Public Institutions to be Twenty Guineas per annum unless the copies be periodically posted with type with additions and corrections throughout the year, in which case the subscription for each copy supplied will be Thirty Guineas per annum.

Section 5. In the case of all other Subscribers, including Marine Insurance Companies, the subscription to be Twelve Guineas per annum for each copy, unless periodically posted with type with additions and corrections throughout the year, in which case the subscription will be Twenty-five Guineas per annum for each copy supplied.

Section 6. For the convenience of Subscribers not resident in London, or whose Register Books are not posted, a Supplement, containing the additions to, and corrections made in, the Register Book to be printed fortnightly, in such convenient form as to admit of its transmission by Post, so that such parties may be furnished, from time to time, with the latest and most complete information.

Section 7. The superintendence of the affairs of the Society to be under the direction of a General Committee composed of Merchants, Ship Owners, and Underwriters (twenty-four elected in London, namely, nine by the Committee of Lloyd's, twelve by the Committee of the London General Shipowners' Society, and three by the Committee of the Institute of London Underwriters, and thirty-seven at the principal Outports), and the following, namely:— Shipbuilders and/or Engineers, not exceeding ten, who may be elected by the General Committee; additional Members not exceeding twelve, who may be elected by the General Committee; past Chairmen, Deputy-Chairmen, and Chairmen of Classification of the Society, who may be elected by the General Committee, and the following *ex-officio* members, namely:—The Chairman, or, in his absence, the Deputy-Chairman, of the Corporation of Lloyd's; the Chairman, or, in his absence, the Deputy-Chairman, of the London General Shipowners' Society; the Chairman, or, in his absence, the Deputy-Chairman, of the Institute of London Underwriters, and the Chairman of each Branch Committee established abroad.

Any member (except an *ex-officio* member, or a member elected by the General Committee) who fails to attend any meetings of the General Committee for a period of six consecutive months, without leave of absence, shall cease to be a member, and his place shall be filled up in the usual way.

NOTE.—Official intimation to be given in June of each year whether the Chairman or Deputy-Chairman of the Corporation of Lloyd's, the Chairman or Deputy-Chairman of the London General Shipowners' Society, and the Chairman or Deputy-Chairman of the Institute of London Underwriters, are to be the *ex-officio* members for the ensuing twelve months.

Section 8. The General Committee reserve the right of varying or withdrawing the representation of Outports, and of Shipbuilders and Engineers; also the representation of Shipbuilders, Engineers, Steel Makers, and Forgemasters on the Technical Committee hereinafter mentioned, as well as the mode of election of members.

Section 9. 1. Seven of the Members elected in London, namely, three representatives of Lloyd's, three representatives of the London General Shipowners' Society, and one representative of the Institute of London Underwriters, to retire annually by rotation, but to be eligible for re-election. The vacancies so arising to be filled by the election of three representatives by the Committee of Lloyd's, three representatives by the Committee of the London General Shipowners' Society, and one representative by the Committee of the Institute of London Underwriters.

2. Of the Members elected at the Outports twenty-one to retire at the end of four years, and seven of the Members elected at Liverpool and the nine Members elected at Glasgow to retire annually. The retiring Members are eligible for re-election.

3. All Members elected by the General Committee are to retire at the end of four years, and are to be eligible for re-election.

Section 10 The Committee to appoint Sub-Committees of Classification, to be so regulated that each Member of the General Committee may, in rotation, take his turn of duty thereon throughout the year.

Section 11. The Committee to appoint from their own body, annually, a Chairman and Deputy-Chairman; and also a Chairman or Chairmen of the Sub-Committees of Classification.

Section 12. The Secretary, Clerks, and Servants of the Society, and the Surveyors, to be appointed by and be under the direction of the General Committee.

Section 13. Special meetings to be convened by order of the Chairman, or Deputy-Chairman, or on the requisition of any three Members.

Section 14. All elections and appointments to be made by ballot, excepting when in the election of Chairman, Deputy-Chairman, or Chairman or Chairmen of the Sub-Committees of Classification, only one person is nominated for each office.

Section 15. No Member of the Committee to be permitted to be present on the decision of the classification of any ship of which he is the owner, or wherein he is directly, or indirectly, interested.

Section 16. 1. The Committee to be empowered to make such Bye-laws for their own government and proceedings as they may deem requisite, not being inconsistent with the original Rules and Regulations under which the Society was established; but no new Rule or Bye-law to be introduced or any Rule or Bye-law altered, without special notice being given for that purpose at the Meeting of the Committee next preceding that at which such Motion is intended to be made; such notice to be inserted in the summons convening the meeting.

2. No new Rule, or alteration in any existing Rule materially affecting the classification of Ships, to be applied compulsorily to vessels of which the plans have been submitted and approved before the expiration of six months after the date when the change has been adopted.

Section 17. 1.—Technical Committee of Lloyd's Register of Shipping.

2. The Technical Committee to be constituted as follows:—

	Ship Owners.	Under-writers.	Ship-builders.	Engineers.	Others.	TOTAL.
Ex-officio—						
The Chairman of Lloyd's Register	1	–	–	–	–	1
The Deputy-Chairman of Lloyd's Register...	1	–	–	–	–	1
The Chairman of Sub-Committees of Classification	–	1	–	–	–	1
Nominated by—						
The General Committee of Lloyd's Register	5	3	2	2	–	12
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The Institution of Engineers and Shipbuilders in Scotland	–	–	1	1	–	2
The Shipbuilding Conference	–	–	5	–	–	5
The National Association of Marine Engine-builders	–	–	–	3	–	3
The Institute of Marine Engineers	–	–	–	1	–	1
The Society of Consulting Marine Engineers and Ship Surveyors	–	–	–	1	–	1
The Dry Dock Owners' and Repairers' Central Council	–	–	–	–	2	2
The Iron and Steel Institute	–	–	–	–	1	1
The British Iron and Steel Federation ...	–	–	–	–	1	1
The National Forgemasters' Association ...	–	–	–	–	1	1
The Honourable Company of Master Mariners	–	–	–	–	1	1
The Institution of Electrical Engineers ...	–	–	–	–	1	1
The British Electrical and Allied Manufacturers' Association	–	–	–	–	1	1
The Technical Committee	3*	–	2	2	–	7
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*Superintendents.

The above nominations to be subject to confirmation by the General Committee.

3. The function of the Technical Committee is to consider any technical problems connected with the Society's business, and any proposed alterations in the existing Rules, or frame new Rules, for the classification, survey and building of ships and machinery.

4. The term of office of all members to be four years, one-fourth retiring each year, the members so retiring to be eligible for renomination for a second term. No member, other than the Chairman and/or Vice-Chairmen, who has served for two periods of four years to be eligible for renomination for a third term until after the expiration of at least one year. In the event of any vacancy occurring before the expiration of a term of four years a representative to be nominated to fill the vacancy for the unexpired portion of the term.

5. With the exception of the Superintendents nominated by the Technical Committee, only those who are actually partners in firms, or directors or managers of joint stock companies, or of similar status, to be eligible for membership.

6. The Technical Committee to appoint from their own body, biennially, a Chairman, who must be a member of the General Committee, and, if desired, two Vice-Chairmen, who need not be members of the General Committee. The same members to be not eligible to hold office for more than four years in succession, unless on the occasion of the third election a ballot—to be taken whether there be any other candidates or not—shows a majority in their favour of at least three-fourths of the members present. The appointment of Chairman and of Vice-Chairmen to be confirmed by the General Committee.

7. Meetings of the Technical Committee to be convened as often and at such times and places as may appear necessary, but there shall be at least three meetings in each year.

8. Members desiring to propose alterations in, or additions to, the Rules for the classification, survey or building of ships and machinery shall give notice of all such proposals in writing to the Secretary.

Every meeting to be convened by notice from the Secretary, if possible one month before the date of meeting; and the Secretary to send to each member an agenda paper as soon as possible thereafter.

9. Any proposal of the Technical Committee involving any amendment of, or addition to, the Rules for the classification, survey or building of ships and machinery to be reported to the General Committee, who will refer them to a Special Meeting of the General Committee, as required by Section 16 of the Rules.

10. The Technical Committee to be empowered:—

(i) to draw up, if they so desire, by-laws for governing procedure at meetings;

(ii) to appoint Panels of the Committee;

(iii) to co-opt to the main Committee, or to such Panels, representatives of any organisation or industry or private individuals for the purpose of considering any particular problem.

11. The General Committee reserve to themselves the right of varying, adding to, or rescinding, at their discretion, any or all the foregoing Rules.

Section 18. All Reports of survey to be made in writing by the Surveyors according to the form prescribed, and submitted for the consideration of the General Committee, or of the Sub-Committees of Classification; but the character assigned by the latter to be subject to confirmation by the General Committee.

Section 19. 1. The reports of the Surveyors (and all documents and proceedings relating to the classification of ships) are to be carefully preserved and shall, subject to the approval, in his absolute

discretion, of the Chairman, or the Deputy-Chairman, or the Chairman of the Sub-Committees of Classification, be open to the inspection of the Owner and of any other person authorised in writing by the Owner.

2. Copies of the original reports (if the ships be already classed, but not otherwise), so far as relates to the dimensions, scantlings, fastenings, and materials, in cases where the correctness of the reports in these particulars is certified by the builders are granted on application.

Section 20. Ships which have been built at a port where there is not a Surveyor are to be surveyed on their arrival at a port to which a Surveyor has been appointed. In carrying out this survey, due regard is to be had to the circumstance of such vessels having been exempted from supervision while building.

Section 21. In every case in which the Character assigned to a ship may be proposed, on survey, to be reduced, notice is to be given in writing to the Owner, Master, or Agent, with an intimation that if the reduction be objected to, the Committee will be ready to direct a special survey, on the Owner, Master, or Agent agreeing to pay the expenses attending the same, provided on the said survey there shall appear sufficient ground for the proposed reduction.

Section 22. 1. When the Surveyors consider repairs to be requisite, they are respectfully to communicate the same in writing to the Owner, Master, or Agent, and if such repairs be not entered upon within a reasonable time, a corresponding report is to be made, as soon as possible, to the Committee for their decision thereon.

2. All repairs of Ships or Machinery required at Ports where there is a Surveyor to this Society, in order to their obtaining a Character in the Register Book, or to their retaining the Characters assigned to them therein, must be carried out under the inspection, and to the satisfaction of the Society's Surveyors. Ships or machinery repaired at Ports where there is no Surveyor to this Society must be surveyed by one of the Society's Surveyors at the earliest opportunity.

Section 23. Parties considering the repairs suggested by the Surveyor to be unnecessary or unreasonable may appeal to the Committee, who will direct a special survey to be held; but should the opinion of the Surveyor be confirmed by the Committee, then the expense of such special survey is to be paid by the party appealing.

Section 24. The Surveyors to the Society not to be permitted (without the especial sanction of the Committee) to receive any fee, gratuity, or reward whatsoever for their own use or benefit, for any service performed by them in their capacity of Surveyors to this Society, on pain of immediate dismissal.

Section 25. The Surveyors will be directed to attend on Special Surveys of ships or machinery while building or under damage or repair, when required by Merchants, Shipowners, or Underwriters; the charge for which is to be regulated according to the nature and extent of the service performed. In all cases, the application for the assistance of the Surveyors must be made in writing addressed to the Secretary.

Section 6. While the Committees of the Society use their best endeavours to ensure that the functions of the Society are properly executed, it is to be understood that neither the Society nor any Member of any of its Committees is under any circumstances whatever to be held responsible for any

inaccuracy in any report or certificate issued by the Society or its Surveyors, or in any entry in the Register Book or other publication of the Society, or for any error of judgment, default or negligence of any of its Committees or any Member thereof, or the Surveyors, or other Officers or Agents of the Society.

Section 27. The Funds and Accounts to be under the authority and control of the Committee.

Section 28. Fees are chargeable for all surveys held by the Society's Surveyors at ports in the United Kingdom in accordance with established scales.

For all surveys held at ports abroad a fee will be chargeable according to the nature and extent of the services rendered.

Travelling expenses incurred by the Surveyors in connection with the above services are also chargeable.

Section 29. The class of a vessel is liable to be withheld, or, if already granted, may be withdrawn or expunged from the Register Book in the case of non-payment of any fees or expenses chargeable on account of such vessel.

Section 30. Certificates of Classification, signed by the Chairman, Deputy-Chairman, or Chairman of the Sub-Committees of Classification, and countersigned by the Secretary, will be granted on application.

71, FENCHURCH STREET, LONDON, E.C.3.
31st July, 1947.

GENERAL REGULATIONS

RELATING TO THE

CLASSIFICATION OF STEEL VESSELS.

PERIODICAL SPECIAL SURVEYS, &c.

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GENERAL REGULATIONS

RELATING TO THE

CLASSIFICATION OF STEEL VESSELS.

1. Classification. (*a*) *General.*—Steel vessels built in accordance with the Society's Rules and Regulations, or with alternative arrangements equivalent thereto, will be classed so long as they are found upon careful annual and periodical survey to be in a fit and efficient condition for the safe conveyance of dry and perishable cargo.

(*b*) *Class* 100A.—This class will be assigned to steel vessels built in accordance with the Society's Rules and Regulations and the scantlings set forth therein for vessels having the maximum draught permitted by the dimensions.

(*c*) *Class* 100A *"With Freeboard."*—This class will be assigned to steel vessels built in accordance with the Society's Rules and Regulations and the scantlings set forth therein for vessels having less than the maximum draught permitted by the dimensions, or such modification in these scantlings as may be approved in any special case by the Committee with the written consent of the owners.

(*d*) *Class* 100A *"Carrying Petroleum in Bulk."*—This class will be assigned to steel vessels built in accordance with the "Rules for the construction of vessels intended to carry petroleum in bulk." Where departures from these Rules are permitted on account of the nature of the cargo and other circumstances the class may be suitably modified. A special notation will be added to indicate the system of construction adopted.

(*e*) *Class* 100A *"For Special Service."*—Vessels in which the scantlings are equivalent to the general requirements of the Rules and the special tables for such vessels may be classed 100A, with a notation showing the particular service in which they are engaged, as—100A "Dredger."

(*f*) *Class* A *"For Special Service."*—Vessels intended for special services may receive the class A without a numeral prefixed, provided the details of the scantlings and arrangements are approved by the Committee. Where the vessel is intended for other than river or inland water service the class will be—"With Freeboard."

To the class A will be affixed notations showing the particular services for which the vessels are intended, such as "For river services"; "For towing services"; "For Channel services" and "For coasting services."

In the case of vessels intended for channel and coasting services, the particular Channel and geographical limits of coasting will be defined, *e.g.*, "Bristol Channel"; "Newhaven-Dieppe" and "Buenos Aires and Monte Video."

(*g*) *Notation for Ice Strengthening* :—Where a special notation "Strengthened for Navigation in Ice" is desired, additional strengthening is to be fitted in accordance with Section 40.

(*h*) *Equivalent Arrangements.*—Deviations from the Rules will be allowed provided they are submitted to the Committee and considered by them to be equivalent to the requirements of the Rules.

The builder shall obtain the owner's sanction to such deviations when the Committee deem it to be necessary.

2. Submission of Plans.—Where it is intended to build vessels for classification in the Register Book, plans of midship section and profile with deck and other plans showing the proposed dimensions, scantlings and arrangements, are to be submitted by the Builders through the local Surveyors for the approval of the Committee.

3. Proper Loading of Vessels.—The scantlings and arrangements given in the Rules are not framed to provide for any special concentration of loading, and if such is proposed to be adopted the Committee may require additional strengthening to be fitted.

Where an owner desires the Committee to make provision for exceptional ballast or loaded conditions, arrangements should be made so that the necessary particulars be given on the plans when these are submitted for approval.

4. Special Survey during Construction.—Vessels intended for classification in the Register Book are to be built under the Society's Special Survey and vessels so built will be entitled to the distinctive mark ✠ in the Register Book.

During the progress of construction, from the laying of the keel to the completion of a vessel, it is the duty of the Surveyors to examine the material and workmanship in order to ensure that the requirements of the Rules and the approved plans are satisfactorily carried out. The Surveyors are required to point out as early as possible anything that is objectionable, or that is not in accordance with the Rules or with the plans approved by the Committee for the particular vessel.

5. Equipment.—The figure 1 placed after the character assigned to a vessel indicates that the anchors, cables, and hawsers of a vessel are in good and efficient condition and are in accordance with the requirements of the Rules.

In the case of vessels classed "For Special Services," the figure 1 indicates that the equipment is considered by the Committee to be sufficient for the particular service in which the vessel is to be engaged.

In cases in which the requirements of the Rules as to equipment have not been complied with, or in which the equipment is found to be insufficient in quantity or defective in quality, a line will be inserted in place of the figure 1, thus 100A–.

6. Main and Auxiliary Engines and Boilers. *General*—The main and auxiliary engines and boilers, steering engines, all pumps, evaporators, and feed water heaters and pressure filters for essential services of vessels intended for classification, or already classed, in the Register Book, are to be constructed under the Society's Special Survey. Appropriate records will be made in the Register Book *in red*, such as ✠LMC3,45 (Lloyd's Machinery Certificate 3,45), or ✠NE&B3,45 (New Engines and Boilers, 3,45), or ✠NE3,45, or ✠NB3,45.

7. Novel Forms of Construction.—Where the proposed construction of a vessel or of the engines or boilers is novel in design or involves the use of unusual material, and where experience has not sufficiently justified the principle or mode of application involved, the notation "Experimental" will be inserted under the class of the vessel in the Register Book, where the Committee consider such a course is desirable.

If, in the opinion of the Committee, the engines or boilers are so inefficient as to imperil the vessel's safety, no class will be assigned to the vessel.

8. Date of Build.—The date of completion of the Special Survey of vessels built under the Society's inspection will be taken as the date of build.

9. Vessels not built under Survey.—The requirements of the Committee for the classification of vessels which have not been built under the Society's Survey are set forth in the Rules.

10. Periodical Special Surveys. (*a*) *General.*—To entitle steel vessels to retain the characters assigned to them in the Register Book, they are required to be subjected to Periodical Special Surveys. These surveys become due at 4-yearly intervals, the first from the date of build and thereafter from the date of the previous Periodical Special Survey.

A Periodical Special Survey may be commenced at any time, but must be completed within 12 months. No survey must extend beyond 6 months after its due date.

In any case in which a vessel upon completion is not immediately put into commission, but is laid up for a period, the Committee, upon application by the Owner, prior to the vessel's proceeding to sea, may direct an examination of the vessel to be made in dry dock by the Society's Surveyors, and if as the result of such survey the vessel as regards hull, engines, boiler and equipment be reported in all respects free from deterioration, the next Periodical Special Survey becomes due 4 years from the date of such examination.

(*b*) *Record of Periodical Special Surveys in Register Book.*—Vessels which have satisfactorily passed a Periodical Special Survey will have notations made against their names in the Register Book indicating the date and place of such survey, thus :—*ss*Lon.–4,46. Vessels which have complied with the full Special Survey requirements for vessels 24 years old and every 12 years thereafter, will have a record of *ss*Lon.–4,46(Dr.), indicating that the special drilling clause has been complied with. Where a Periodical Special Survey is not completely carried out at one time, the date recorded in the Register Book will be the date at which the principal part of the requirements is complied with.

(*c*) In the cases of vessels carrying petroleum in bulk, the Committee will be prepared, at the request of the Owner, to sanction the examination and testing of the oil compartments so that all the compartments are examined and tested every 4 years, and that the period which elapses between consecutive examinations and testing of each compartment shall not exceed 4 years.

In such cases the Certificate of Classification will be endorsed "Progressive Survey of Oil Tanks" and this notation will also be printed in the Register Book.

(*d*) *Annual or Occasional Surveys.*—All vessels are subject to Annual or Occasional Surveys, when practicable. The requirements in respect of such surveys are set forth in the Rules, page 28.

(*e*) *Main and Auxiliary Engines and Boilers.*—The main and auxiliary engines and boilers are to be submitted to Periodical Survey as required by the Rules.

11. Survey of Repairs.—All repairs of vessels, engines and boilers that may be required in order that the vessels may retain their character in the Register Book, must be carried out under the inspection and to the satisfaction of the Society's Surveyor when one is stationed in the district. When such repairs are effected at a port where there is no Surveyor to this Society, the vessel must be surveyed by one of the Society's Surveyors at the earliest opportunity.

When the Surveyors consider repairs necessary, they are respectfully to communicate their recommendations in writing to the owner, master, or agent; and, if such repairs be not undertaken within a reasonable time, a report is to be made as soon as possible to the Committee.

12. Notice of Surveys.—The Society's Surveyors are required to attend for the purpose of holding surveys in their district, but the duty of giving notice when the attendance of the Surveyors is required to carry out Periodical Special Surveys or to supervise repairs, rests with the owners, masters, or agents. If such notice is not given, and the requisite surveys are not carried out, the characters of vessels are liable to be expunged from the Register Book.

13. Appeal from Surveyor's Recommendations.—Interested parties, considering the recommendations of the Society's Surveyors, as to the construction or repair of a vessel, to be in any case unnecessary or unreasonable, are entitled to appeal to the Committee, who will direct a special survey to be held; but should the opinion of the Surveyor be confirmed by the Committee, the expense of such special survey is to be paid by the party appealing.

14. Certificates of Class. (*a*) *General.*—Certificates of first entry of classification and certificates of character upon subsequent completed surveys on vessels, engines, and boilers, signed by the Chairman, the Deputy-Chairman, or the Chairman of the Sub-Committees of Classification, and countersigned by the Secretary, will be granted on application.

(*b*) *Provisional Certificates.*—If the hull of a vessel has been built in accordance with the Rules, and a satisfactory report has been received from the Society's Surveyors, a provisional certificate will be issued, if desired, stating the class to which the vessel will be entitled when the engines and boilers have been fitted on board in accordance with the Rules, and the Committee's requirements otherwise complied with.

15. Reconsideration of Class.—If, upon survey of any vessel, a material reduction is found to have taken place in the thickness of the plating and angles, the classification of the vessel will be reconsidered by the Committee. In every case in which the class assigned to a vessel is proposed to be reduced, notice is to be given in writing to the owner, master, or agent, with an intimation that if the reduction be objected to, the Committee will be ready to direct a special survey, if the owner, master, or agent agrees to pay the expenses attending the same, provided on the same special survey there shall appear sufficient ground for the proposed reduction of Class.

16. Withdrawal of Class. (*a*) *Non-Compliance with Rules.*—When the Rules as regards surveys on the hull, engines or boilers of a steam or motor vessel, or on the hull, masts, spars, or rigging of a sailing vessel have not been complied with, so that the vessel is not entitled to retain her class in the Register Book, the character will be expunged with a red line, under which the date of such withdrawal will be recorded.

(*b*) *Reported defects.*—When it is found from reported defects in the hull, engines or boilers of a steam or motor vessel, or in the hull, masts, spars, or rigging of a sailing vessel, that the vessel is not entitled to retain her class in the Register Book, the character will be expunged with a black line, under which the date of such withdrawal will be recorded.

(*c*) *Owner's request.*—When the class of a vessel is withdrawn from the Register Book by the Committee in consequence of a request from the owner, this will be indicated by the insertion of three dots (...) in the Register Book.

(*d*) *Infringement of freeboard conditions.*—Where any vessel proceeds to sea with a less freeboard than that approved by the Committee, or where the freeboard mark is placed higher on the vessel's sides than the position assigned by the Committee the vessel's class will be liable to be expunged from the Register Book.

February, 1946.

PERIODICAL SPECIAL SURVEYS OF STEEL VESSELS.

(A) GENERAL REQUIREMENTS (*see also* B, C *and* D).

1. The vessel is to be placed on blocks of sufficient height in a dry dock, or on a slipway; proper stages are to be made, and the holds and peaks are to be cleared for examination.

2. In vessels having a single bottom the limber boards and ceiling equal to not less than two strakes fore and aft on each side are to be removed, one such strake being taken from the bilges. Where the ceiling is fitted in hatches, the whole of the hatches and one strake of ceiling at the bilges are to be removed.

3. If the vessel has a double bottom a sufficient amount of ceiling is to be removed to enable the condition of the inner bottom to be ascertained, and if it is found that the plating is free from dirt and rust, the removal of the remainder of the ceiling may be dispensed with. The bilges and limbers all fore and aft are to cleaned out, so as to allow of these parts being properly examined.

4. The coal bunkers of steam vessels are to be cleared for examination, and ceiling is to be removed as in the holds.

5. The steel work is to be exposed for examination and cleaned. Special attention is to be given to the examination of the ash shoots, and the shell plating in way of the openings.

If the Surveyor deems it necessary he may require holes to be drilled in any portion of the structure where signs of wastage are evident, to ascertain the thickness of the material. Any parts of the structure which are found defective or materially reduced in scantlings are to be made good by materials equal in scantlings and quality to those approved in the original construction of the vessel.

Where considered necessary by the Surveyor, the surfaces are to be recoated.

6. In cases in which the inner surface of the bottom plating is covered with cement or asphalt, the removal of this covering may be dispensed with, provided it be carefully inspected, tested by beating or chipping, and found sound and adhering satisfactorily to the steel.

7. The double bottom tanks are to be tested by a head of water to the light water-line, but in no case less than 8 feet above the inner bottom. Double bottom compartments, which are used for the carriage of oil fuel, are to be tested by a head of water extending to the load water-line, or by a head sufficient to give the maximum pressure which can come upon them in practice, whichever is the greater.

Where peak tanks or deep tanks for carrying water ballast are fitted, their watertightness is to be tested by a head of water not less than 8 feet above the crown of the tank.

All water ballast tanks are to be cleaned out to admit of their being properly examined inside, special attention being given to the tanks under the boiler spaces.

Deep tanks constructed for carrying oil but not used solely for this purpose, also peak tanks used for carrying oil fuel, are in each case to be examined internally and are to be tested by a head sufficient to give the maximum pressure which can be experienced in practice or 8 feet, whichever is the greater.

In the case of motor and other vessels burning oil fuel and carrying it in the double bottom and in oil fuel bunkers, these compartments need not be examined internally provided upon a general external examination the Surveyor finds their condition to be satisfactory. In these cases the tanks are to be tested by a head as stated above.

8. When a deck originally required to be 3 inches thick is worn to $2\frac{1}{2}$ inches, or $2\frac{1}{2}$ inches to 2 inches, it is to be renewed. If, however, such deck is found on survey to be in good condition the case will, upon application, receive the consideration of the Committee.

9. The masts, spars, rigging, anchors, and general equipment are to be examined and either found, or placed in good and efficient condition.

10. The hatch covers and supports throughout are to be examined in position at the hatchways, and, if defective, are to be renewed or made good.

The Surveyor should satisfy himself as to the efficiency of the tarpaulins, cleats, battens and other means of securing the hatches.

The ventilator coamings and covers are to be examined, and special care is to be taken to see that they are in an efficient condition.

11. The rudder, quadrant, tiller, steering gear, engine and its connections and control gear are to be examined.

Special attention is to be paid to the examination of all parts of rod and chain gears. All pins are to be examined and the chain is to be cleaned and examined for wear and tear. Any length of chain so worn that its mean diameter at its most worn part is reduced to the size as given in the Table on page 28 is to be renewed.

The various parts of the auxiliary steering gear are to be assembled and examined to ascertain that the gear is in good and workable condition.

All replacements of chains are to be subjected, under the Society's supervision, to the proof tests as set forth for short link cables in Section 14 of the Rules for Quality and Testing of Materials, and the certificates are to be produced. It is recommended that, in addition, the breaking test as required in Section 14 mentioned above should also be applied to these chains, and that the tests be made at a proving establishment recognised by the Committtee.

It is recommended that repaired chains be tested by the repairers and a certificate to that effect be produced.

It is recommended that a set of spares as required by Section 33, clause 5 of the Rules be provided.

12. The windlass, pumps, sluice valves, watertight doors, and air and sounding pipes are to be carefully examined.

The Surveyor is to see that striking plates are fitted under all sounding pipes.

13. Where holds are insulated for the purpose of carrying refrigerated cargoes, and the vessel in way of the insulation was examined by the Society's Surveyors at the time such insulation was fitted, it will be sufficient to remove the limbers and hatches to enable the plating to be examined.

14. The freeboard recorded in the Register Book is to be verified.

15. The main and auxiliary engines and boilers and electrical equipment are to be examined and favourably reported on by the Society's Engineer Surveyors.

For Periodical Special Surveys of main and auxiliary engines and boilers and electrical equipment *see* page 23.

(B) AT EACH PERIODICAL SPECIAL SURVEY AFTER THE FIRST.

THE FULL REQUIREMENTS OF (A) TOGETHER WITH THE FOLLOWING :—

1. An additional amount of ceiling in the holds and in coal bunkers is to be removed to enable the condition of the inner bottom plating, stanchion feet, and the bottom plating of bulkheads and tunnel sides to be examined. If the Surveyor deems it necessary, the whole of the ceiling is to be removed.

2. In vessels having a single bottom the limber boards and ceiling equal to not less than three strakes fore and aft on each side are to be removed, one such strake being taken from the bilges. Where the ceiling is fitted in hatches, the whole of the hatches and one strake of ceiling in the bilges are to be removed.

3. All double bottom and other tanks, including oil fuel bunkers are to be cleaned out, to admit of their being properly examined inside.

4. The plating in way of the sidelights is to be examined.

5. The chain cables are to be ranged for inspection, and the anchors and chains examined and placed in good working condition. If any length of chain cable is found to be reduced in mean diameter at its most worn part to the extent indicated in Table 56, it is to be renewed.

6. The chain locker is to be examined internally.

(C) AT EACH PERIODICAL SPECIAL SURVEY WHEN THE VESSEL IS 10 YEARS OLD AND OVER.

THE FULL REQUIREMENTS OF (A) AND (B), TOGETHER WITH THE FOLLOWING :—

1. The steel work is to be cleaned and the rust removed.

2. Casings of pipes, spar ceiling and lining in way of the sidelights are to be removed as required by the Surveyor.

3. The whole of the ceiling in the bunkers is to be removed. If it is found, after removal of portions of the ceiling in the holds, that the steel work is in good condition, free from rust, and coated, the removal of the whole may be dispensed with.

4. The inside of coal bunkers and the parts in way of the boilers are to receive the Surveyors' particular attention.

5. The cement chocks at the vessel's sides are to be examined, and portions removed, so that the condition of the adjacent steel work can be ascertained.

6. Where the holds are insulated for the purpose of carrying refrigerated cargoes, and the vessel in way of the insulation was examined by the Society's Surveyors at the time such insulation was fitted, the limbers and hatches are to be lifted, and enough insulation is to be removed in each of the chambers to admit of the framing and plating being exposed to satisfy the Surveyor of their general condition.

7. All mast and bowsprit wedging is to be removed. If the plating is doubled in way of the wedging, the latter need be removed only at the first Periodical Special Survey after the vessel is 10 years old. At this same Survey the standing rigging of sailing ships is to be lifted, and the service and parcelling stripped off the nips, bends and splices for examination; if, however, the rigging has been recently fitted, particulars of the cases are to be submitted for the consideration of the Committee. The bobstay pins, the deadeyes and rigging screws to the whole of the standing rigging, also all bolts or pins and fittings are to be carefully examined.

(D) AT THE FIRST PERIODICAL SPECIAL SURVEY HELD AFTER THE VESSEL IS 24 YEARS OLD AND AT EVERY 12 YEARS THEREAFTER OR AT THE NEXT PERIODICAL SPECIAL SURVEY AFTER THE EXPIRATION OF THE LATTER PERIOD.

THE FULL REQUIREMENTS OF (A), (B) AND (C), TOGETHER WITH THE FOLLOWING :—

1. The shell plating is to be drilled at such parts as the Surveyors may consider necessary to satisfy themselves as to the thickness. The number of holes drilled on each side of the vessel is to be in no case less than three in each strake of plating not covered with cement, the holes being drilled about amidships, and in the vicinity of the peak bulkheads. All paint as well as rust is to be entirely removed before the plates are gauged, and the actual thicknesses at all parts drilled are to be detailed in the Surveyors' report.

The plating in way of cement in the bottom need not be drilled, provided the cement is found to be adhering satisfactorily to the plating, and the Surveyors consider drilling at this part unnecessary.

2. Where the holds are insulated for the purpose of carrying refrigerated cargoes, and the vessel in way of the insulation was examined by the Society's Surveyors at the time such insulation was fitted, the limbers and hatches are to be lifted, and additional insulation is to be removed in each of the chambers to admit of the framing and plating being exposed to satisfy the Surveyor of the general condition of the same, and to enable the shell plating to be drilled as required by the Regulations.

3. All mast and bowsprit wedging is to be removed whether the plating in way is doubled or not.

4. In sailing vessels the requirements of (C), clause 7, are to be complied with.

For further requirements applicable to vessels carrying petroleum in bulk, *see* Section 24 of the Rules for Vessels Intended to Carry Petroleum in Bulk.

February, 1946.

PERIODICAL SPECIAL SURVEYS OF MAIN AND AUXILIARY ENGINES AND BOILERS, ELECTRICAL EQUIPMENT AND EXHAUST STEAM TURBINES CONNECTED TO THE MAIN SHAFTING OF STEAM RECIPROCATING ENGINES.

ENGINES AND BOILERS OF STEAM VESSELS.

1. The machinery and boilers of all steam ships are to be surveyed annually if practicable, and in addition are to be submitted to a Special Survey upon the occasions of the vessels undergoing the Periodical Special Surveys, prescribed in the Rules, unless the machinery and boilers have been specially surveyed within a period of twelve months.

2. At these Special Surveys, and on other occasions if deemed necessary by the Surveyors, the propeller, stern-bush, sea connections, and their fastenings, are to be examined while the vessel is in dry dock.

3. The screw shaft is to be drawn at intervals of not more than three years in the cases of shafts fitted with continuous liners, and of shafts fitted with approved glands, or other approved appliances, at their after ends to permit of them being efficiently lubricated. In the cases of other screw shafts, they should be drawn at intervals of not more than two years. (On the application of Owners, the Committee will be prepared to give consideration to the circumstances of any special case.)

4. (*a*) The cylinders, pistons, slide valves and crank shafts of reciprocating engines, and the blading, rotor shafts, and rotors as far as practicable, of turbine engines, together with thrust and intermediate shafts, pumps and condensers, are to be examined, and if necessary the condenser is to be tested. Where reduction gears are fitted, the shafts, shaft bearings, and teeth of the gears are to be examined.

(*b*) Where exhaust steam turbines are connected to the main shafting of steam reciprocating engines, through reduction gearing and hydraulic clutches or other mechanical means, or electric motors, the turbines, gearing and clutches of electric motors are to be examined as far as practicable. If found to be satisfactory, they need not be dismantled.

Where the power of the turbine is transmitted through a hollow gear wheel shaft attached to the main shafting by means of a coned coupling the coned end of the internal driving shaft is to be exposed and the shaft to be examined as far as practicable.

These requirements will also apply to exhaust steam turbines, and other appliances driven by them, which are used in conjunction with the main engines.

5. The valves, cocks, pipes and strainers of the pumping arrangements are to be examined.

6. The boilers, superheaters and economisers are to be examined internally and externally, and if deemed necessary by the Surveyors, the pressure parts are to be drilled or tested by hydraulic pressure; the safe working pressure is to be determined by their actual condition.

7. The principal mountings on boilers, superheaters and economisers are to be opened up and examined and the safety valves set under steam to pressures not greater than 3 per cent. above the approved working pressures of the respective parts.

The remaining mountings are to be examined externally and are to be opened up for internal examination if deemed necessary by the Surveyor.

8. At each Periodical Special Survey after the first, a selected number of main steam pipes, also of auxiliary steam pipes over 3 inches bore, made of iron, steel, or solid drawn copper, supplying steam for essential services at sea, are to be removed for examination and tested by hydraulic pressure to double the working pressure.

Alternatively, all steam pipes as described above are to be tested in place to double the working pressure. In either case, sufficient lagging is to be removed at the discretion of the Surveyor to facilitate examination and hammer testing.

Copper steam pipes as described above, but having a brazed longitudinal joint, are to be entirely stripped and tested to double the working pressure at each Special Survey.

9. At each Periodical Special Survey the oil fuel pumps for oil fired main, auxiliary and donkey boilers are to be opened up for examination. A general examination is to be made of all valves, tanks, pipes and deck control gear in connection with the oil fuel and steam smothering installations, and the installations are to be tested under working conditions.

10. At all Boiler Surveys the oil fuel and steam smothering installations are to be tested under working conditions and a general examination made of the fuel tank valves, deck control gear and oil discharge pipes between the pumps and furnaces.

11. The electrical equipment is to be examined.

12. If satisfactory, these Surveys will be recorded in the Register Book thus:—" LMC3,45 " *in red* or " B&MS3,45 " *in red.*

13. "LMC" (LLOYD'S MACHINERY CERTIFICATE) denotes that the machinery and boilers are fitted in accordance with the Rules; and when followed by a date, indicates that they were found at that time to be in good condition. "MS" with a date denotes that the engines at that time were found upon inspection to be in good condition. "BS" with a date denotes that the boilers were found upon inspection at that time to be in good condition.

14. "B&MS" (BOILERS AND MACHINERY SURVEYED), with a date, denotes that the boilers and machinery, though not fitted strictly in accordance with the Rules, were found upon inspection at that time to be in good condition.

15. In the event of either the machinery or boilers appearing to be impaired to such an extent as to render it desirable that either or both be specially surveyed within the periods prescribed above, a Certificate for either machinery or boilers for a limited period will be granted according to the nature of the case.

BOILERS (INCLUDING PRESS BOILERS).

1. Water tube boilers and their superheaters and economisers are to be specially surveyed annually.

2. The boilers, superheaters and economisers of all vessels, including sailing ships, are to be specially surveyed when four years old, also when six years old, and subsequently they are to be specially surveyed annually.

3. Domestic boilers intended for working pressures exceeding 50 lb. per square inch or having heating surfaces greater than 50 square feet, also press boilers and similar apparatus in floating whale-oil factories are to be specially surveyed when four and six years old, and subsequently they are to be specially surveyed annually.

4. At these surveys the boilers, superheaters and economisers are to be examined internally and externally, and if deemed necessary by the Surveyors, the pressure parts are to be drilled or tested by hydraulic pressure; the safe working pressure is to be determined by their actual condition.

5. The principal mountings on boilers, superheaters and economisers are to be opened up and examined, and the safety valves set under steam to pressures not greater than 3 per cent. above the approved working pressures of the respective parts. The remaining mountings are to be examined externally and are to be opened up for internal examination if deemed necessary by the Surveyor.

6. At each Periodical Special Survey the oil fuel pumps for oil fired main, auxiliary and donkey boilers are to be opened up for examination. A general examination is to be made of all valves, tanks, pipes and deck control gear in connection with the oil fuel and steam smothering installations, and the installations are to be tested under working conditions.

7. At all Boiler Surveys the oil fuel and steam smothering installations are to be tested under working conditions and a general examination made of the fuel tank valves, deck control gear and oil discharge pipes between the pumps and furnaces.

8. If satisfactory these Surveys will be recorded in the Register Book thus:—"BS3,45" *in red,* "DBS3,45" *in red,* and "Pr.BS3,45" *in red* respectively.

9. "BS" (BOILERS SURVEYED) or "DBS" (DONKEY BOILER SURVEYED), or "Pr.BS" (PRESS BOILERS SURVEYED) with a date, denotes that the boilers were found upon inspection at that time to be in good condition.

10. In the event of the boilers, superheaters or economisers appearing to be impaired to such an extent as to render it desirable that they be specially surveyed within the periods prescribed above, a Certificate for a limited period will be granted according to the nature of the case.

PETROL, PARAFFIN, AND HEAVY OIL ENGINES AND THEIR AUXILIARIES.

1. (*a*) In the cases of vessels propelled by petrol, paraffin, and heavy oil engines a complete survey of the machinery, as detailed in clause 2, is to be held upon the occasions of the vessels undergoing the Periodical Special Surveys prescribed in the Rules, unless the machinery has been thus surveyed within a period of twelve months.

(*b*) At each intervening period of two years a Modified Survey of the machinery, as detailed in clause 3, is to be held.

2. Complete Periodical Survey.—The Complete Periodical Survey required in clause 1, paragraph (*a*), will consist of the following:—

(*a*) The main engines and their auxiliaries are to be examined throughout, viz., all cylinders, pistons, valves and valve gears, connecting rods and their top and bottom end brasses, crossheads, guides, pumps, clutches, reversing gears, crank, thrust and intermediate shafts, propeller, stern bush, sea connections and their fastenings.

(*b*) If compressed air is employed, the cylinders, pistons and valves of the compressors are to be examined. The air receivers are to be examined internally if possible, and, together with the air pressure pipes, are to be cleaned internally, if necessary, by means of steam, or otherwise. If the air receivers cannot be examined internally, they are to be tested by hydraulic pressure to twice the working pressure, attention being specially given in the case of welded receivers to the end and longitudinal joints.

(*c*) If electric ignition is employed the electric leads are to be examined and the system is to be tested. The magnetos are to be sent for inspection and overhaul to competent repairers.

(*d*) Where reduction gears are fitted, the shafts, shaft bearings and teeth of the gears are to be examined.

(*e*) Separate fuel storage tanks and daily service tanks, their fittings and connections are to be examined and, if deemed necessary by the Surveyor, the tanks are to be tested to the same pressure as specified for new tanks.

(*f*) The valves, cocks, pipes and strainers of the pumping arrangements are to be examined.

(*g*) In cases where steam is used for essential services at sea, the condenser, air, circulating and feed pumps are to be examined and the steam pipes examined and tested in accordance with the Rules for the Periodical Surveys of Engines and Boilers of Steam Vessels.

(*h*) The electrical equipment is to be examined.

(*i*) The manœuvring of the engines is to be tested under working conditions.

3. Modified Survey.—The Modified Survey required in clause 1, paragraph (*b*), will consist of the following, viz. :—

(*a*) The parts of the engines which the engineers of the vessel open up for adjustment and overhaul should be examined and reported upon. The survey is to include, for each main engine, the examination of at least two pistons, with their cylinders, covers and valves, connecting rods and their top and bottom end brasses, two of the main crank shaft journals and bearings, and one of the intermediate shaft bearings. If these are all satisfactory, their condition may be taken as representing that of the other similar parts.

In the case of main engines having less than four cylinders, one of each of the parts aforementioned will be considered sufficient if found satisfactory.

Where petrol, paraffin, and heavy oil engines are fitted for driving auxiliary machinery, a similar course is to be adopted, but in this case one of each of the parts aforementioned of each engine will be sufficient, if found to be satisfactory.

(*b*) The valve gears are to be examined, as far as practicable. If found to be satisfactory, they need not be dismantled.

(*c*) The pumps, air compressors and clutches (where fitted), and reversing gears, are to be examined as far as practicable. If found to be satisfactory, they need not be dismantled.

(*d*) If compressed air is employed, the air receivers are to be examined internally if possible, and, together with the air pressure pipes, are to be cleaned internally, if necessary, by means of steam, or otherwise.

(*e*) If electric ignition is employed the electric leads are to be examined and the system is to be tested. The magnetos are to be sent for inspection and overhaul to competent repairers.

(*f*) Separate fuel storage tanks and daily service tanks, their fittings and connections, are to be examined externally, and, if deemed necessary by the Surveyor, the tanks are to be tested to the same pressure as specified for new tanks.

(*g*) If the examination reveals any defects, the Surveyor should recommend such further opening up as he may consider to be necessary.

4. Screw Shaft.—The screw shaft is to be drawn at intervals of not more than three years in the cases of shafts fitted with continuous liners, and of shafts fitted with approved glands, or other approved appliances, at their after ends to permit of them being efficiently lubricated. In the cases of other screw shafts, they should be drawn at intervals of not more than two years. (On the application of owners, the Committee will be prepared to give consideration to the circumstances of any special case.)

5. Record of Survey.—If the various parts mentioned in clauses 2 or 3 are found to be in a satisfactory condition, and the Surveyor finds that the machinery generally is in good order, he should recommend the vessel to have a fresh record of LMC, or LMC(M) as the case may be.

In the event of either the main or auxiliary machinery appearing to be impaired to such an extent as to render it desirable that either or both be specially surveyed within the periods prescribed above, a certificate for a limited period will be granted according to the nature of the case.

6. **Continuous Surveys.**—In the case of motorships fitted with heavy oil engines, if arrangements be made to open up the various parts of the machinery in regular rotation from time to time, so that the Society's Surveyors may examine the whole of the machinery every four years, the Rule requirements, both for Modified and Complete Periodical Surveys, will be complied with if such a procedure be adopted.

When the full requirements of the Complete Periodical Survey have been complied with a record of LMC (CS) (with date), (Lloyd's Machinery Certificate, Continuous Survey) will be assigned in the Register Book, the date being that of the completion of a cycle of the Continuous Survey.

ELECTRICAL EQUIPMENT.

1. On the occasions of the vessels undergoing the Periodical Special Surveys prescribed in the Rules, the electrical equipment is to be examined.

2. (*a*) Where the electrical equipment is for lighting purposes only, the installations are to be generally examined and tested under working conditions.

(*b*) The fittings on all main and sub-distribution switchboards and boxes are to be examined to ensure that the circuits are not overfused.

(*c*) The electric cables are to be examined as far as practicable without dismantling any fixtures or casings unless such dismantling is deemed to be necessary as the result of tests and observation.

(*d*) A test is to be made on generators, cables, heaters, fittings, etc., and the insulation resistance is to be not less than 100,000 ohms.

3. (*a*) Where the electric generators are also used for supplying power for driving auxiliary machinery, steering gear, windlass or refrigerating machinery, the prime movers are to be opened out for examination in accordance with the Rules for the survey of Machinery set forth on pages 19 to 21 of the Rules.

(*b*) The generators and all motors driving essential auxiliary machinery are to be examined as far as practicable.

(*c*) All fittings on main and sub-distribution switchboards and boxes are to be examined to ensure that the circuits are not overfused.

(*d*) The electric cables are to be examined as far as practicable without dismantling any fixtures or casings unless such dismantling is deemed to be necessary as the result of tests and observation.

(*e*) A test is to be made on generators, motors, cables and other apparatus, heaters, fittings, etc., and the insulation resistance is to be not less than 100,000 ohms.

(*f*) All generators are to be run in turn or simultaneously; all main switches and current breakers are to be operated, and all lamps, heaters, motors and other appliances run, though not necessarily under full load or simultaneously.

ANNUAL OR OCCASIONAL SURVEYS OF STEEL VESSELS.

1. At Annual, or Occasional Surveys, vessels are to be examined generally as far as possible.

2. When a vessel is placed in dry dock, or on a slipway, the Society's Surveyors at the port are to avail themselves of the opportunity to examine the bottom of the vessel, and to examine the vessel throughout, as far as practicable, in order to satisfy themselves generally as to her condition.

3. Special attention should be given to the examination of the ash shoots and the shell plating in way of the openings, and to the condition of the hatchways, ventilators, and other openings in the deck.

4. Rod and chain steering gears are to be surveyed annually when special attention is to be paid to the examination of all parts of the gear. All pins are to be examined and the chain in the vicinity of the blocks is to be cleaned and examined for wear and tear. Any length of chain so worn that its mean diameter at its most worn part is reduced to the size given in the following Table is to be renewed.

Original Diameter of Chain.	Mean Diameter requiring Renewal of Chain.	Original Diameter of Chain.	Mean Diameter requiring Renewal of Chain.	Original Diameter of Chain.	Mean Diameter requiring Renewal of Chain.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
$\frac{3}{8}$	$\frac{5}{16}$	$\frac{13}{16}$	$\frac{23}{32}$	$1\frac{1}{4}$	$1\frac{1}{8}$
$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{8}$	$\frac{25}{32}$	$1\frac{5}{16}$	$1\frac{3}{16}$
$\frac{1}{2}$	$\frac{7}{16}$	$\frac{15}{16}$	$\frac{27}{32}$	$1\frac{3}{8}$	$1\frac{1}{4}$
$\frac{9}{16}$	$\frac{1}{2}$	1	$\frac{29}{32}$	$1\frac{7}{16}$	$1\frac{5}{16}$
$\frac{5}{8}$	$\frac{9}{16}$	$1\frac{1}{16}$	$\frac{15}{16}$	$1\frac{1}{2}$	$1\frac{3}{8}$
$\frac{11}{16}$	$\frac{5}{8}$	$1\frac{1}{8}$	1	$1\frac{9}{16}$	$1\frac{7}{16}$
$\frac{3}{4}$	$\frac{21}{32}$	$1\frac{3}{16}$	$1\frac{1}{16}$	$1\frac{5}{8}$	$1\frac{15}{32}$

The various parts of the auxiliary steering gear are to be examined in order to ascertain that the gear is in good and workable condition.

All replacements of chains are to be subjected, under the Society's supervision, to the proof tests as set forth for short link cables in Section 14 of the Rules for Quality and Testing of Materials, and the certificates are to be produced. It is recommended that, in addition, the breaking test as required in Section 14 mentioned above should also be applied to these chains, and that the tests be made at a proving establishment recognised by the Committee.

It is recommended that repaired chains be tested by the repairers and a certificate to that effect be produced.

It is recommended that a set of spares as required by Section 33, clause 5 of the Rules be provided.

5. Whenever the engines or boilers are taken out, the bearers, with the floor plates, girders, rivets, and other parts of the structure, under them, are to be surveyed; and whenever the bottom plating is to be cemented, a survey is to be held prior to the cement being laid. The masts and spars are to be subject to examination by the Surveyors when deemed necessary by them on other occasions besides Special Surveys.

6. The requirements for the survey of main and auxiliary engines and boilers and electrical equipment are set forth at page 17.

VESSELS NOT BUILT UNDER SURVEY.

1. **Hull.**—(*a*) Where a character is required for vessels not surveyed while under construction, application must be made to the Committee in writing. Drawings, with scantlings of the vessel marked thereon, as well as particulars of the testing of the steel used in the construction of the vessel, should be furnished.

A special examination is to be made, for which purpose the vessel is to be placed on high blocks in a dry dock or on ways; the hold is to be cleared and proper stages made; the rivets and plating of the bottom are to be thoroughly examined; the close ceiling in the hold is to be removed as required when a vessel is 10 years old and over. The coal bunkers of steam vessels are to be cleared; the whole of the frames, stringers, floor plates, keelsons, engine and boiler bearers, beam knees, watertight bulkheads, rivets, and inner surface of the plating are to be exposed to view; all oxidation is to be removed from these parts and from the outside plating, rivets, keel, stem, sternpost, and rudder.

In cases where the inner surface of the bottom plating is coated with cement or asphalt, if the coating be carefully inspected, and tested by beating or chipping, and found sound and adhering satisfactorily to the steel, its removal may be dispensed with, provided that upon the removal of a portion, the plating, frames, and rivets under it be found in satisfactory condition.

(*b*) When the vessel is so prepared, the Surveyors are to ascertain the scantlings of the various parts, and verify the particulars given on the drawings furnished, drilling the shell plating and other parts where deemed necessary for this purpose. A few rivets are to be removed from various parts to ascertain their quality and the character of the countersinking and workmanship. A full report is to be made on a first entry report form in order that a character may be assigned to the vessel.

2. **Machinery.**—To facilitate the survey, plans of the following items, together with the particulars of the materials of important forgings, also of those used in the construction of the boilers and air receivers, should be furnished:—

STEAMERS.

(*a*) Boilers.
(*b*) Superheaters.
(*c*) Arrangement and drainage of steam pipes.
(*d*) Crankshaft.
(*e*) Reduction Gear.
(*f*) Screw shaft.
(*g*) Oil fuel pumping arrangements and oil fuel tanks not forming part of the structure of the vessel.
(*h*) Bilge and ballast pumping arrangements.
(*i*) Electrical Circuits.

OIL ENGINED VESSELS.

(*a*) Crankshaft.
(*b*) Clutch, reversing and reduction gear.
(*c*) Screw shaft.
(*d*) Air Receivers.
(*e*) Oil fuel pumping arrangements and oil fuel tanks not forming part of the structure of the vessel.
(*f*) Bilge and ballast pumping arrangements.
(*g*) Boilers.
(*h*) Electrical Circuits.

The main and auxiliary machinery, also steam pipes, compressed air pipes, and boilers are to be examined as required for Periodical Special Surveys, and their working pressures are to be determined from their actual scantlings in accordance with the Rules.

The screw shaft is to be drawn and examined.

The bilge, ballast and oil fuel pumping arrangements are to be examined and amended as necessary to comply with the Rules.

Oil burning installations are to be examined as required for Periodical Special Surveys and found, or amended, to comply with the requirements of the Rules; they are also to be tested under working conditions.

The electrical equipment is to be examined as required at Periodical Special Surveys.

The whole of the machinery is to be tried under working conditions to the Surveyors' satisfaction.

A First Entry Report is to be prepared by the Surveyors.

3. Periodical Surveys.—The Periodical Surveys are subsequently to be held as in the case of vessels built under survey.

71, Fenchurch Street, London, E.C.3.

17th October, 1946.

BUILDING OF STEEL VESSELS

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BUILDING OF STEEL VESSELS.

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RULES FOR THE BUILDING OF STEEL VESSELS.

SUBMISSION OF PLANS.

Section 1. Submission of Plans.—Where ships are built for classification in the Register Book, plans of Midship Section, Longitudinal Section, Decks, Scheme of Riveting, Watertight Bulkheads, Deep Tanks, Oil Fuel Bunkers, Widely Spaced Pillars and Girders, Panting Arrangements, Strengthening of Bottom Forward, Propeller Brackets, Balanced Rudder, Bossed Framing, Cruiser Stern, Large Deckhouses, and any other plans which may be required, showing the details of the scantlings and arrangements proposed, are to be submitted through the local Surveyors for the approval of the Committee before the work is commenced.

TYPES OF VESSELS.

Section 2. 1. (*a*) The Rules and Tables give the scantlings for two basic types of vessels which are denoted—"Full Scantling Vessel" and "Complete Superstructure Vessel."

(*b*) The scantlings for the "Full Scantling Vessel" will entitle the vessel to the maximum draught that can be assigned for the dimensions of the ship.

(*c*) The scantlings for the "Complete Superstructure Vessel" will entitle the vessel to the maximum draught that can be assigned when the Depth for Freeboard Assignment is taken to the deck next below the complete superstructure deck.

(*d*) For vessels which are intermediate in character between the two basic types, the scantlings are to be determined by the interpolation between the requirements for full scantling vessels and for complete superstructure vessels in proportion to the draught desired.

(*e*) Vessels in which the draught desired is less than could be assigned as a "Complete Superstructure Vessel" may be specially considered by the Committee, and the scantlings adjusted according to the circumstances of the case and the draught desired, with the written consent of the owners.

In such cases, however, the standard of strength in relation to the draught, must not be less than that represented by the two basic types referred to above.

(*f*) The class 100A will be assigned to vessels which comply with the requirements for a full scantling vessel.

(*g*) The class 100A "with freeboard" will be assigned to vessels which have a draught less than the maximum that can be assigned for the corresponding full scantling vessel.

(*h*) The Rules and Tables are framed for vessels of average ratios of breadth to depth, and of ratio of length to depth not greater than $13\frac{1}{2}$. Where the proportions are abnormal, special structural arrangements will be required to secure conformity with the standard of strength of the Rules.

DETERMINATION OF SCANTLING NUMERALS.

Section 3. 1. **Principal Dimensions.**—(*a*) **The Length (L)** is to be measured from the fore side of the stem to the after side of the sternpost on the summer load water line.

The length (L) of vessels having cruiser sterns is to be taken as 96 per cent. of the extreme length measured from the fore side of the stem to the aftermost part of the cruiser stern, but is not to be less than the length from the fore side of the stem to the after side of sternpost, or to the centre of the rudder stock where a sternpost is not fitted.

(*b*) **The Breadth (B)** is to be the greatest moulded breadth of the vessel.

(*c*) **The Depth (D)** is to be measured at the middle of length, from the top of keel to the top of beam at side of uppermost continuous deck. Where the draught desired corresponds to that which could be assigned as a Complete Superstructure vessel the depth (D) is to be measured to a point 7 feet 6 inches above the deck from which the freeboard is assigned in vessels not exceeding 300 feet in length, and 8 feet above this deck in vessels greater than 300 feet in length. Where a vessel has more than one complete tier of superstructures, (D) is to be measured to the deck next above that from which the freeboard is assigned. For the purpose of these Rules, the deck to which the depth (D) is measured is to be regarded as the upper deck except where a vessel has more than one complete tier of superstructures.

(*d*) **A Framing Depth (d)** is to be measured vertically at the middle of length, from the top of ordinary floor or the top of double bottom at side to the top of the beams at side of the lowest deck or its equivalent.

(*e*) **Proportions.**—The depth (D) is to be used in determining the proportions, except in way of a strength deck other than the upper deck, where the depth is to be taken to the strength deck. In vessels in which the depth (D) has been modified as prescribed in paragraph (*c*) on account of the draught, the depth to be used in determining the proportions is to be the actual depth to the upper deck.

2. **Scantling numerals.**—The scantlings of the principal parts of the vessel are to be determined by

(1) The depth D

(2) The numerals $L \times D$ and $L \times (B + D)$ which are to be known as the "First Longitudinal Numeral" and the "Second Longitudinal Numeral" respectively.

(3) The proportions $\frac{L}{D}$

(4) The framing depth (d)

KEELS, STEMS, AND STERNFRAMES.

Section 4. 1. **Materials.**—(*a*) Where forgings are made from scrap material, either scrap iron or scrap steel may be used, but a mixture of scrap iron and scrap steel is not to be employed.

(*b*) Where forgings are made of Ingot Steel, the requirements of **Section 10** of the **Rules for the Testing of Materials** are to be complied with.

(*c*) Where castings are used, the requirements of **Section 9** of the **Rules for the Testing of Materials** are to be complied with.

2. **Bar Keels.**—The dimensions of bar keels are to be as given in **Table 1.** The scarphs connecting the lengths of bar keel to each other and of the keel to the stem and sternframe are to have a length of nine times the thickness of the keel, and the rivet holes required in the thin ends of the scarph connections are to be drilled in position.

3. **Flat Plate Keels.**—The breadth and thickness of flat plate keels are to be as given in **Tables 18** and **19,** and intercostal keelson plates, or centre through plates, are to be connected to the keel plate by angles of the dimensions given in **Table 10** for vessels with single bottoms and as given in **Table 6** for vessels with double bottoms. The keel plates are to overlap the stem and the sternframe.

4. **Stems.**—The dimensions of the stem are to be as given in **Table 1,** but may be gradually reduced from the load waterline to the stem head where the sectional area may be 75 per cent of the Table requirements.

5. **Sternframes in Single Screw Vessels.**—(*a*) The dimensions of the sternframe are to be as given in **Table 1,** but may be gradually reduced from the lower part of the rudder trunk to its head where the sectional area may be 50 per cent of that given in the Table.

The length of the sole piece of the sternframe in way of the aperture should be kept as short as possible.

In vessels having cruiser sterns the scantlings of the rudder post should be the same as required for the propeller post.

(*b*) Where the length exceeds 275 feet the foremost or propeller post is to extend above the arch of the sternframe and is to be efficiently connected to a deep transom plate which should be attached to the adjacent deck structure where practicable.

In the case of vessels whose length does not exceed 275 feet this requirement will apply if a cruiser stern is fitted.

(*c*) The sectional area of the sole piece of the sternframe is to be at least 20 per cent greater than that of the propeller post; this increase is to be provided in the thwartship dimension of the sole piece as far as possible.

(*d*) The thickness of the boss of the propeller post is to be at least 60 per cent of the thickness of the sternframe.

(*e*) The lower portion of the sternframe forming the keel connection is to extend forward from the fore side of the propeller post a distance of three times the amidship rule frame spacing, but need not extend forward of the after peak bulkhead provided an efficient attachment is obtained to the keel.

(*f*) In steamers above 350 feet in length the shell plating is to be connected to the sternframe below the boss, with three rows of rivets.

6. **Sternframes in Twin Screw Vessels.**—(*a*) In the case of twin screw steamers which have no propeller aperture sailing vessels and paddle steamers, the dimensions of the sternframe are to be as given in **Table 1,** but may be reduced from the lower part of the rudder trunk to its head, where the sectional area should be 75 per cent of that given in the Table.

(*b*) The lower portion of the sternframe forming the keel connection is to extend forward a distance of twice the amidship rule frame spacing from the fore side of the sternframe, but need not extend forward of the aft peak bulkhead provided an efficient attachment is obtained to the keel.

7. **Sternframes–General.**—(*a*) The lower portion of the sternframe is to be flattened out to give an efficient attachment to the flat plate keel when that form of construction is adopted.

(*b*) The sternpost is to extend to the top of the transom plate and is to be connected thereto by two double riveted angles where the breadth of the post exceeds $7\frac{1}{2}$ inches. The transom plate is to be ·10 inch thicker than the floors and is to have a depth of six times the thickness required for "sternframes with apertures."

(*c*) Where sternframes are made in more than one piece the scarph connections are to have a length of three times the fore and aft dimension of the sternframe and a breadth of one and a half times the fore and aft dimension of the sternframe and are to be connected by four rows of rivets. The thickness of the tips of the scarphs is to be 13 per cent of the thwartship dimension of the post.

In vessels having cruiser sterns, the scarph of the rudder post in single screw ships should not be fitted in the vertical portion of the post above the top gudgeon.

(*d*) Gudgeons are to be forged on, or cast with the sternframe, and spaced to suit the rudder arms. The upper gudgeon should be as near as practicable to the rudder trunk and rudder coupling. The gudgeons are to have a depth of 70 per cent of the rudder head and a thickness of 50 per cent of the diameter of the pintles. The depth of the bottom gudgeon is to be sufficient to take a rudder pintle having a parallel length equal to 40 per cent of the diameter of the rudder head.

(*e*) In high powered vessels and in vessels with rudders of abnormal size or proportions, a plan of the proposed arrangement of the sternframe is to be submitted for the approval of the Committee.

RUDDERS.

Section 5. 1. **Materials.**—(*a*) Where forgings are made from scrap material, either scrap iron or scrap steel may be used, but a mixture of scrap iron and scrap steel is not to be employed.

(*b*) Where forgings are made of Ingot Steel, the requirements of **Section 10** of the **Rules for the Testing of Materials** are to be complied with.

(*c*) Where castings are used, the requirements of **Section 9** of the **Rules for the Testing of Materials** are to be complied with.

2. **Scantlings.**—(*a*) The diameters of rudder heads are to be determined from **Table 41**, on the basis of the speed of the vessel in conjunction with a numeral A × D,

where A is the total area in square feet of the rudder abaft the forward edge of the main piece, and

D is the distance, in feet, of the centre of gravity of area A abaft the centre line of the pintles,

(*b*) The scantlings of the rudder arms, coupling bolts, and other details, are to be in accordance with the requirements of **Tables 42, 43** and **44.**

3. **Single Plate Rudders.**—(*a*) The main piece of single plate rudders is to have a straight taper from below the top pintle to the heel, where it is to be of the size required by **Table 43.** The diameter at the top pintle is to be not less than that of the rudder head. The arms are to be fitted on alternate sides of the plate. Small fillets to arms forged or cast on the main piece are to have a radius of not less than 20 per cent of the distance between the arms. Large fillets are to have a radius at least equal to half the distance between the arms.

(*b*) Where arms are shrunk upon and keyed to the main piece, the diameter of the latter in way of each arm is to be increased 10 per cent to admit of an efficient keyway being cut. This increase in thickness is to be uniform all round the main piece, and is to extend above and below each arm for a distance equal to the increase in diameter, from which points it is to be gradually tapered over a similar distance into the normal diameter of the main piece. The thickness of the key is to be equal to 10 per cent of the diameter of the main piece, and its breadth equal to twice its thickness.

4. **Couplings.**—Where rudder heads are coupled, the dimensions of the bolts and the flanges of the palms are to be as required by **Table 42,** and the width of material outside the bolt holes is not to be less than two-thirds the diameter of the bolts. The bolts are to be "fitted," and the nuts are to be in proportion to the size of the bolts. Locking plates, split pins, or other efficient means are to be adopted to prevent the nuts from turning. The thickness of the tips of the palms of scarphed couplings is to be 13 per cent of the diameter of the head.

5. **Pintles.**—(*a*) The pintles are to be spaced as required by **Table 43,** and the top pintle should be as near as practicable to the rudder trunk. The pintles are to have the same depth as the gudgeons, and the parallel length of the bottom bearing pintle is to be at least 40 per cent of the diameter of the rudder head.

(*b*) The pintles of double plate rudders are to be spaced as required for single plate rudders, having an arm at each pintle.

6. **Rivets.**—(*a*) The rivets in the rudder arms are to be spaced $4\frac{1}{2}$ diameters apart, centre to centre in single plate rudders, and 5 diameters apart in the bows and stays of double plate rudders.

(*b*) Where the breadth of the arm exceeds $4\frac{1}{2}$ inches reeled riveting is to be adopted, and where the breadth of the arms exceeds 7 inches, two complete rows of rivets spaced $4\frac{1}{2}$ diameters apart in each row are to be fitted. Where two complete rows are fitted the rivets are not to be directly opposite each other except at the outer ends of the arms.

(*c*) The rivet holes in rudder plates and arms are to be countersunk, and the rivets are to have full heads and points.

7. **General.**—Efficient arrangements are to be provided to prevent the rudder lifting.

SIDE FRAMING.

Section 6. 1. **Scantlings.**—(*a*) The scantlings of the side frames at the standard frame spacing are set forth in Tables 2, 2A, 3, 3A and 4.

The scantlings of the frames from one half length forward to a point 15 per cent of the length of the vessel measured from the stem on the waterline are to be determined by a value of "d" measured at the half length forward.

(*b*) The scantlings given in Tables 2 and 3 are applicable to flush deck full scantling vessels. In vessels having partial superstructures the scantlings of the frames are to be intermediate between those given in Tables 2 and 2A or 3 and 3A in proportion to the total percentage length of the vessel covered by superstructures, the depth (D) being taken to the same deck in each case. The scantlings given in Table 4 are applicable to complete superstructure vessels.

2. **Spacing.**—The spacing of the frames from centre to centre is to be in accordance with the size of the vessel, and as required by Tables 2, 2A, 3, 3A and 4.

The frame spacing is not to exceed 27 inches between the collision bulkhead and one-fifth of the vessel's length from forward and in the peaks the spacing is not to exceed 24 inches.

The frame spacing round the stern of the vessel at the knuckle may be the same as amidships, but is not in any case to be greater than 30 inches.

3. **Extent of Framing in 'Tween Decks.**—(*a*) **Full Scantling Vessels.** In way of detached superstructures the frames need only extend to the superstructure deck on alternate frames, except as follows:—

Poops.—Intermediate angle frames, which need not be attached at their lower ends, are to be fitted.

Long Bridges.—Intermediate angle frames may be dispensed with except for four frame spaces at each end of the bridge, where the frames as required in the upper 'tween decks are to be extended continuous to the bridge deck.

Short Bridges.—Intermediate angle frames which need not be attached at their lower ends are to be fitted. The arrangement of framing at each end of the bridge is to be the same as for long bridges.

Forecastles.—Intermediate angle frames are to be fitted and scarphed to the frames below or bracketed to the upper deck.

'Tween Decks below Upper Deck.—All the frames are to extend to the upper deck.

(*b*) **Complete Superstructure Vessels.**—The frames need only extend to the upper deck on alternate frames abaft one-fifth of the vessel's length from forward and forward of one-eighth of the vessel's length from aft. From these points forward and aft respectively, intermediate angle frames are to be fitted and scarphed to the frames below or bracketed to the second deck.

(*c*) The arrangements described in the above paragraphs apply only in vessels in which the Rule frame spacing is adopted and so long as such spacing does not exceed 30 inches.

In other cases the frames are to be fitted in the 'tween decks at every frame.

4. **Scantlings of Framings in 'Tween Decks.**—(*a*) **Full Scantling Vessels.** The frames in the detached superstructures where extended to the superstructure deck on alternate frames only are to have scantlings as required for bulb angle frames in peaks but may be ½ inch less in depth.

In the upper 'tween decks all the frames are to be as required for bulb angle frames in peaks but may be ½ inch less in depth.

In the second 'tween decks all the frames are to have the scantlings for required bulb angle frames in peaks.

(*b*) **Complete Superstructure Vessels.**—The frames which only extend to the upper deck on alternate frames and the frames in the second 'tween decks should have the scantlings required for bulb angle frames in peaks but may be ½ inch less in depth.

(*c*) The breadth of the shell flange of the frame is to be suitable for the diameter of the rivets in the shell plating.

(*d*) Where the framing is not continuous the 'tween deck frames are to be efficiently scarphed to the frames below.

(*e*) Where intermediate angle frames are required to be fitted, the scantlings are to be as for angle frames in peaks except those in poops and short bridges in full scantling vessels and those in the upper 'tween decks of complete superstructure vessels abaft one-eighth of the

vessel's length from aft, which may be ½ inch less in depth where the depth of the frame does not exceed 6 inches, and 1 inch less in depth where the depth of the frame is over 6 inches.

(*f*) Where more than one tier of superstructures are fitted the scantlings of the framing in 'tween decks will be specially considered.

5. **Reversed Frames.**—(*a*) Where the framing consists of angle frame with reversed frame, the height to which the reversed frames are to extend is to be such as to make the strength of the framing in the 'tween decks equivalent to that specified in clause 4 above.

(*b*) In vessels exceeding 250 feet in length, alternate reversed frames forward of the three-fifths length are to extend to the forecastle deck or to the upper deck in complete superstructure vessels in which a forecastle is not fitted.

(*c*) The overlap of frame upon reversed frame is to be not less than 4 times the diameter of the rivet.

6. **Cut Frames.**—Where frames are cut at watertight flats, they are to be attached to the plating of the deck by bracket plates of depth and breadth not less than three times the depth of peak bulb angle frames; where the 'tween deck height exceeds 8 feet 6 inches, these brackets are to be increased.

Brackets of the same thickness as the frames to which they are attached are to be fitted at every frame, and are to have not less than two rivets more than required for beam knee bracket plates of the same dimensions. At peak tanks where the flare is excessive, the brackets are to be flanged on the face and, where necessary, increased in size.

7. **General.**—(*a*) Where the height between deck stringers at the side exceeds 8 feet 6 inches at any part, additional transverse strengthening at such part is to be provided.

(*b*) Where hold frames are stopped at the lowest deck they are to be attached to the beams or bracketed to the deck stringer plate where beams are not fitted.

(*c*) The floors in the fore and aft peaks are to have the same thickness as the floors elsewhere.

(*d*) In after peaks the floors are to extend well above the stern tube but where the extension of the floor plates may not be practicable, deep cross-tie plates flanged on both upper and lower edges are to be fitted above the stern tube. The floors and cross-tie plates are to be connected to the frames with rivets spaced not more than 5 diameters apart, centre to centre. Arrangements are to be made to provide sufficient lateral rigidity to long cross-tie plates.

(*e*) In boiler rooms and permanent coal bunkers the thickness of the framing is to be increased ·06 of an inch beyond that given in the Tables.

(*f*) The rivet holes are to be punched from the faying surfaces of the frames and are not to be punched at the turn of the bilge, until the frames are bent to the required shape.

(*g*) The requirements for frames and reversed frames on the floors in single bottom vessels are given in Section 8, clause 3.

(*h*) Where wider frame spacing than that given in the Tables is proposed to be adopted, the requirements of Section 14 are to be complied with.

(*i*) The requirements regarding the framing of cruiser sterns are given in Section 24.

(*j*) The framing in way of deep ballast tanks and oil fuel bunkers and in way of bossing for screw shafts will be specially considered and sketches showing the arrangements proposed are to be submitted for approval.

PANTING ARRANGEMENTS.

Section 7. 1. **Forward of the Collision Bulkhead.**—(*a*) Tiers of beams on alternate frames are to be fitted within the peak below the lowest deck, these tiers being spaced not more than 6 feet apart. The scantlings of the beams are to be as required for upper decks having decks below, Table 13.

(*b*) Stringer plates of the dimensions required for lower deck stringer plates at ends of vessel are to be fitted to each tier of panting beams.

(*c*) If the stringer plates are attached to the outside plating, double angles or single angles having flanges of sufficient breadth to take two complete rows of rivets should be fitted.

Frames at which there is not a beam are to be attached to the stringer plate by a knee, whose depth is to be one-half the breadth of the stringer plate.

(*d*) If the stringer plates are not attached to the shell plating the beams are to overlap the frames and the scantlings of the beams and of their end attachments are given in the Table below.

B		Beam.	Knee.	Rivets.	
Feet.		Inches.	Inches.	No.	Ins.
22	Bulb Angles.	5 ×3 ×·28	15 ×·30	4	$\frac{3}{4}$
26		5 ×3 ×·30	15 ×·32	4	$\frac{3}{4}$
30		$5\frac{1}{2}$ ×3 ×·30	$16\frac{1}{2}$ ×·34	5	$\frac{3}{4}$
34	—	6 ×3 ×·36	18 ×·36	6	$\frac{3}{4}$
38		6 ×3 ×3 ×·32	20 ×·38	6	$\frac{7}{8}$
42		6 ×3 ×3 ×·42	22 ×·42	6	$\frac{7}{8}$
46		7 ×3 ×3 ×·42	24 ×·46	6	$\frac{7}{8}$
50	Channels.	8 ×$3\frac{1}{2}$ ×$3\frac{1}{2}$ ×·42	27 ×·50	7	$\frac{7}{8}$
54		9 ×$3\frac{1}{2}$ ×$3\frac{1}{2}$ ×·48	30 ×·52	8	$\frac{7}{8}$
58		10 ×$3\frac{1}{2}$ ×$3\frac{1}{2}$ ×·56	33 ×·54	9	$\frac{7}{8}$
62		11 ×$3\frac{1}{2}$ ×$3\frac{1}{2}$ ×·60	36 ×·56	10	$\frac{7}{8}$
66		12 ×$3\frac{1}{2}$ ×$3\frac{1}{2}$ ×·64	39 ×·58	11	$\frac{7}{8}$

The stringer plates are to be stiffened on their edges and attached to the intermediate frames by brackets having the same number of rivets as in the beam knees.

The thickness of the shell plating is to be 10 per cent greater than the thickness given in the Tables for the shell plating at the ends where the first longitudinal numeral does not exceed 2,400, and 25 per cent greater where the numeral is 10,000 or above; the increase at intermediate numerals to be in proportion.

2. **Abaft Collision Bulkhead.**—(*a*) The scantlings of the side frames below the lowest deck for a distance equal to at least 10 per cent of the vessel's length measured from the Rule position of the collision bulkhead are to be as in **Table 5.**

(*b*) The rivets connecting the frames to the side plating are to be spaced $5\frac{1}{2}$ diameters apart, centre to centre.

(*c*) The gusset attachments and the corresponding rivets are to be increased 50 per cent above the requirements of **Table 8.** The number of rivets in the angles which attach the bracket plates to the margin plate are also to be 50 per cent greater than required by **Table 8.**

Where double angles are fitted connecting the bracket plates to the margin plate, the angles attaching the floors to the margin plate are also to be doubled. Where single angles double riveted are fitted, the angle attaching the floor plate to the margin plate is to have the same scantlings as the angle outside the margin, and is to be through-riveted thereto.

(*d*) Beam knees are to be in accordance with **Section 15, clause 3.**

(*e*) Side stringers, spaced 6 feet apart and extending throughout the region defined in **paragraph** (*a*) above, are to be fitted in line with the stringers in the peak and are to have the scantlings given in **Table 5.**

(*f*) Each side stringer is to be attached to the shell plating by a single angle having a single row of rivets in each flange.

(*g*) If the side stringers referred to above are not fitted, the thickness of the side shell plating is to be increased as required by **clause 1** (*d*).

3. **Deep 'Tween Decks.**—In vessels with deep 'tween decks additional intercostal side stringers are to be fitted at the fore end, supported by web frames if considered necessary.

4. **After Peak.**—(*a*) In the after peak tiers of beams and stringers are to be fitted similar to those required in the fore peak, except that the spacing of the stringers may be 8 feet. Where the counter has excessive flare web frames and stringers or other equivalent strengthening is to be fitted where considered necessary by the Surveyors.

(*b*) Floors and cross-tie plates are to be fitted as required by **Section 6, clause 7** (*d*).

FLOOR PLATES IN VESSELS HAVING SINGLE BOTTOMS.

Section 8. 1. Spacing.—A floor plate is to be fitted and riveted to every frame and is to extend across the middle line, except where a vertical centre through plate is fitted, in which case the floors are to be efficiently connected to it on each side by double vertical angles having the same thickness as the centre plate.

2. Scantlings.—(*a*) The depth and thickness of the floor plates are to be in accordance with the requirements of **Table 9.** The thickness is to be increased above the midship thickness by ·04 inch in the engine space and by ·10 inch in the boiler space.

(*b*) The upper edges of the floor plates are not to be below the level of the upper edge at the centre line.

(*c*) Flanged bracket plates, of the same thickness as the floors, are to be fitted at the bilges, extending to a height above the base line equal to twice the depth of the floor at the centre line and having an overlap on the floor, inside the line of the frame, equal to the depth of the floor at the centre line.

(*d*) In vessels having considerable rise of floor the depth of the floor plates may be required to be increased.

(*e*) Towards the ends of the vessel the floor plates are to be gradually increased in depth in order that the sides may be efficiently connected when the brackets may be omitted.

(*f*) Floor plates forming part of bulkheads are not to be less than 36 inches in depth, measured from the top of the keel, and the thickness is to be as required for the bottom strake of bulkhead plating.

3. Frames and Reverse Frames on Floors.—(*a*) Where the side frames extend only to the lower turn of bilge, the frames on the floor plates are to be of the same thickness as the floor and the breadths of the flanges sufficient for the diameter of the rivet used.

(*b*) Where the side frames are carried to the centre line of the ship, the overlap of the floor plate on the frame need only be sufficient to take one row of rivets.

(*c*) The reversed bars, fitted on the upper edges of the floors, are to have flanges of the size given for reversed frames in peaks and the thickness is to be the same as that of the floor. Where reversed bars are cut, a doubling angle forming a butt strap is to be fitted having at least three rivets on each side of the butt.

(*d*) Where floors are flanged on their upper edges as a substitute for fitting reversed bars, the thickness of the floors is to be increased ·02 inch and the breadth of the flange is to be equal to the breadth of the reversed bar omitted. Floors are not to be flanged in the engine space, under boiler bearers, or in way of the strengthening of bottom forward.

(*e*) Double reversed angles, extending from side to side, are to be fitted on every floor in the engine space and under boiler bearers.

(*f*) The thickness of all the reversed bars in the boiler space is to be increased by ·10 inch.

4. Watercourses.—Watercourses are to be formed above the frames through all the floor plates on each side of the middle line, also at the lower turn of the bilges in vessels of full form, as well as through the vertical centre plate and intercostal keelsons, where such keelsons are fitted, in order that water may reach the pumps freely.

5. Vessels Loading or Discharging Aground.—In the case of small vessels intended to load or discharge while lying aground it is recommended that the bottoms be additionally strengthened in order to withstand the exceptional stresses to which they may be subjected.

6. Strengthening of Bottom Forward.—The requirements regarding the strengthening of the fore part of the bottom of steamers are contained in Section 11.

KEELSONS IN VESSELS HAVING SINGLE BOTTOMS.

Section 9. 1. **Scantlings.**—The scantlings and arrangements of keelsons are to be as required by Table 10.

2. **Continuity.**—Where the keelsons are cut at the bulkheads the longitudinal strength is to be efficiently maintained.

Where keelsons, or other longitudinal members are required for a certain portion of the length of a vessel, care is to be taken to avoid any abrupt discontinuity of strength at their terminations.

3. **Middle Line Keelsons.**—(*a*) All middle line keelsons are to extend as far forward and aft as practicable.

(*b*) Where flat plate keels are adopted intercostal or centre through plate keelsons are to be fitted.

(*c*) Intercostal keelsons are to be attached to the floors by single angles having the same thickness as the intercostal plates.

(*d*) Centre through plate keelsons are to have the thickness given in Table 10, and the floors are to be attached to them by double vertical bars of the same thickness as the keelson plate. Foundation plates of the same thickness as the centre plate and not less than 12 inches in breadth are to be fitted above the floors, one on each side of the centre keelson, and are to be attached thereto by the continuous angles.

4. **Side Keelsons.**—(*a*) Where the moulded breadth of the vessel does not exceed 30 feet, one side keelson is to be fitted on each side of the centre line, and where the breadth is above 30 feet and does not exceed 54 feet, two side keelsons are to be fitted.

All side keelsons are to extend as far forward and aft as practicable.

(*b*) Double angles, of the dimensions given in **Table 10,** or single angles of equivalent sectional area, are to be fitted on the upper edge of the keelson.

(*c*) Side keelsons are to have intercostal plates attached to the shell plating by angles of the same thickness as the intercostal plates.

(*d*) In the engine space additional side keelsons are to be fitted and are to be attached to the shell.

(*e*) Where the intercostal plates are flanged on their lower edges as a substitute for fitting attachment angles to the outside plating, their thickness is to be increased by ·02 inch. Intercostals are not to be flanged in way of the strengthening of bottom forward.

5. **Increased thickness in Boiler Room.**—The thickness of the centre and side keelson plates and bars not covered by cement is to be increased by ·10 inch in boiler rooms.

6. **Butt Connections.**—All angle and bulb angle bars of keelsons are to be in long lengths, and the butts are to be properly shifted and strapped with angles of the same thickness not less than 2 feet in length. The butts of the keelson plates are to be properly shifted and are to be riveted as required by **Table 39.** The continuous keelson angles are to be attached to the reversed frames.

7. **Strengthening of Bottom Forward.**—The requirements regarding the strengthening of the fore part of the bottom of steamers are contained in Section 11.

DOUBLE BOTTOMS.

Section 10. 1. **Scantlings and Arrangements.**—The scantlings and attachments of the structure forming the double bottom are to be as required by **Tables** 6, 7 and 8.

2. **Centre Girder.**—(*a*) The centre girder is to have the depth and thickness given in **Table 6.**

(*b*) In vessels not exceeding 250 feet in length with machinery fitted amidships, and in vessels of 160 feet and under in length with machinery fitted aft, the angles attaching the centre girder to the keel plate and the inner bottom plating may be single except throughout the engine room and underneath the thrust seating and forward of the half length.

(*c*) In vessels exceeding 250 feet in length with machinery fitted amidships, and in vessels exceeding 160 feet in length with machinery fitted aft, these angles are to be double throughout.

(*d*) Single angles, double riveted, may, if desired be fitted attaching the centre girder to the keel plate and to the inner bottom in vessels exceeding 250 feet in length with machinery fitted amidships, and in vessels exceeding 160 feet in length with machinery fitted aft, where the first longitudinal numeral does not exceed 14850.

The flanges of these angles are to be of sufficient width to take two complete rows of rivets, and the thicknesses are to be as given in **Table 6.**

In such cases double angles as required by **Table 6** are to be fitted attaching the centre girder to the inner bottom throughout the engine room, underneath the thrust seating, and from half length forward to the collision bulkhead.

Double angles, as required by **Table 6,** are also to be fitted attaching the centre girder to the keel plate from half length forward to the collision bulkhead.

3. **Side Girders.**—(*a*) One side girder is to be fitted on each side of the centre line when the rule breadth of the vessel exceeds 34 feet and does not exceed 64 feet, and two side girders are to be fitted when the breadth does not exceed 78 feet. In vessels not exceeding 34 feet in breadth the solid floors in the holds and boiler room are to be stiffened midway between the centre line and the margin plate, and a girder is to be fitted on each side for the full length of the engine room and at the forward end beyond the half length.

Side girders are to be extended as far forward and aft as practicable.

(*b*) Additional side girders are to be fitted in way of the engine seating and thrust block seating.

(*c*) All side girders under the engine seating and thrust block are to have double angles, or single angles with flanges broad enough to take double riveting, fitted on their upper edges.

4. **Floors.**—(*a*) Solid floors of the thickness given in **Table 6** are to be fitted on every frame in the engine space and on every frame forward of the three-fifths length. They are also to be fitted under the boiler bearers and under the bulkheads. Partial solid floors are to be fitted under the thrust seating.

(*b*) In vessels engaged in heavy trades, such as ore-carrying, it is recommended that solid floors be fitted on every frame.

(*c*) Except as provided above, solid floors may have a maximum spacing of 10 feet.

(*d*) Bracket floors of the scantlings given in **Tables 7** and **7A** may be fitted between the solid floors required by the previous paragraph.

(*e*) The brackets attaching the frames and reversed frames to the centre girder, and to the margin plate, are to be of the same thickness as the floors, and are to be flanged on their outer edges. The breadth of the bracket plates is not to be less than three-fourths of the depth of the centre girder.

(*f*) Solid floors under machinery space, thrust block and boiler bearers, are to be attached to the centre girder by double angles or single bars double riveted. Elsewhere floors may have single attachment bars.

(*g*) On bracket floors the vertical bars at the intercostal side girders are to be of the same scantlings as the reversed frames of these floors.

(*h*) The riveted attachments of the bulb angle frames and reversed frames to the brackets at the centre line and margin plate and to the vertical stiffeners on the intercostal girder are to comply with the requirements of **Table 7A.**

Where the frames and reversed frames are angles the number of rivets is to be as required by the Table for 5 inch bulb angles.

(*i*) Where it is desired to reduce the span of bulb angle frames and reversed frames by fitting vertical struts, the scantlings of the struts and the attachments at their ends are to be as required by **Table 7A.**

(*j*) The thickness of the watertight floors in the double bottom is to be increased ·08 inch beyond that given in **Table 6,** but the thickness of these floors need not exceed that given in the Table for floors in boiler room. Where the depth of the centre girder exceeds 36 inches, stiffeners of the size given in **Table 7B** are to be fitted to all watertight floors and to be spaced not more than 30 inches apart. The ends of the stiffeners are to be as close as possible to the boundary bars on the floors.

(*k*) The spacing of the rivets in the athwartship flange of the angle attaching the floors to the margin plate is to be the same as the spacing of the rivets in the fore and aft flange.

(*l*) Additional stiffening under the heels of widely spaced pillars is to be fitted as required by **Section 16, clause 3** (*d*) and (*e*).

5. **Double Reversed Frames in Machinery Space.**—Double reversed angles, or single bars with flanges broad enough to take two complete rows of rivets, are to be fitted on every floor in the engine space, on each floor below the boiler bearers and on each floor below the thrust seating. They are to extend in all cases from the middle line to beyond the girder outside the engine seating.

6. **Inner Bottom Plating.**—(*a*) The inner bottom plating is to be continuous longitudinally, but transverse plating may be fitted in way of the watertight bulkheads provided the margin plates and middle line strake be made continuous. The attachment of the transverse plates to the longitudinal inner bottom plating is to comply with the requirements of **Table 39** but is not to be less than double riveted.

(*b*) If ceiling is not fitted on the inner bottom under the hatchways, this plating is to be increased ·08 inch in thickness in way of the hatchways. The thickness of the middle line strake is in no case to be less than that of the inner bottom plating. Where the cargo is intended to be discharged by grabs or similar mechanical appliances it is recommended that the inner bottom plating be increased ·20 inch in thickness.

7. **Margin Plates.**—(*a*) The margin plate is to be of the depth and thickness required by **Tables 6** and **8.** The full depth of the margin plate is to be maintained from the collision bulkhead to the after three-fifths length, abaft which the depth may gradually be reduced to 85 per cent of the midship depth.

(*b*) Where gusset plates are fitted connecting the outside bracket knees to the inner bottom, the horizontal flanges

of the margin plates are to be of sufficient width to permit the landing edge of the inner bottom plating to be kept clear of the gusset plate attachment. The gusset plates are to have the same thickness as the floors.

8. **Tank Side Brackets and Angles.**—(*a*) The bracket plates connecting the side frames to the margin plate are to have the thickness given in **Table 8** and are to extend up the bilges to the height given in the same Table, this height being measured at the inner edge of the frame and maintained throughout. These brackets are to be flanged on the edge or stiffened by a reversed bar.

(*b*) Where the framing depth "d" exceeds 26 feet and the attachment outside the margin plate required by **Table 8** consists of double angles, the floor plate is also to be connected to the margin plate by double angles of the same width of flange. Where a single angle, double riveted, is fitted outside the margin plate, the angle fitted inside is to have the same dimensions as those of the external bar, and is to be riveted thereto.

(*c*) Where the bracket plate is attached to the margin plate by double vertical angles, the number and diameter of the rivets through the bracket plate and side framing are to be equivalent to the number and diameter of the rivets through the vertical bars, excluding the rivets in the gusset connection. Where the bracket plate is attached to the margin plate by a single angle, the number and diameter of the rivets through the bracket plate and side framing are to be equal to the number and diameter of the rivets in the vertical bar, with an addition equivalent to 50 per cent of the number of rivets in the gusset connection.

(*d*) Where the tank margin plate is approximately horizontal, the breadth of the horizontal arms of the brackets is not to be less than the rule depth of the margin plate, and is to be suitably increased to provide equivalent attachment where gussets are required by the Table.

(*e*) For refrigerated vessels carrying oil fuel in double bottom, *see* **Section 20C, clause 4.**

9. **Increased Thicknesses in Machinery Space.**—(*a*) In the boiler space, including any donkey boiler recess, the floor plates and brackets, centre and side girders, inner bottom plating, margin plate and angle bars not covered by cement, and in the engine space the inner bottom plating, are to be increased in thickness as required by **Tables 6 and 7.** The thickness of the frame brackets outside the tank is to be increased ·10 inch in the boiler space.

(*b*) Where the machinery is fitted aft, the thicknesses given in **Table 6** for inner bottom plating in engine room are to be adopted throughout the engine room. In the boiler room the thicknesses are to be increased by the increments which would have been added if the machinery had been fitted amidships.

10. **Flanging.**—Floor plates are not to be flanged. Intercostals may be flanged, except under engines, thrust blocks, and pillars, and within the range of the additional strengthening of the fore part of the bottom, as required by **Section 11.** Where intercostals are flanged the thickness is to be increased by 10 per cent.

11. **Manholes and Covers.**—(*a*) Manholes with suitable steel covers are to be provided in the inner bottom plating in sufficient numbers to permit adequate ventilation, and to allow of easy access for the examination of all parts of the internal structure.

(*b*) Manholes and lightening holes are to be provided in the solid floors and intercostal side girders in such numbers and positions as will render all parts of the double bottom readily accessible. The edges of manholes should be smooth.

(*c*) Where the manhole covers are attached by bolts to the inner bottom plating, doubling plates or rims are to be fitted to receive the fastenings of the covers.

For refrigerated vessels carrying oil fuel in double bottom, *see* **Section 20C, clause 4.**

(*d*) Where ceiling is not fitted and the manhole covers or fittings to the double bottom of cargo holds project above the tank top, an angle coaming is to be fitted round each manhole with a hatch either of wood or steel.

12. **Free Passage of Air between Divisions.**—(*a*) Ample provision is to be made for the free passage of air and water from one division to another and to the air pipes, by fitting the liners short, or by having a sufficient number of holes as near to the inner bottom as possible.

(*b*) Air pipes are to be fitted in accordance with the requirements of **Section 34, clause 10.**

13. **Workmanship and Testing.** — All watertight joints are to have the steel surfaces fitted as close as possible to each other, and are to be caulked efficiently. The double bottom is to be caulked and made watertight, and each compartment on completion is to be tested with a head of water representing the maximum pressure which could be experienced in service.

14. Vessels Loading or Discharging Aground.—In the cases of small vessels intended to load or discharge while lying aground, it is recommended that the bottoms be additionally strengthened in order to withstand the exceptional stresses to which they may be subjected.

15. **Drainage.**—The pumping and draining arrangements are to be in accordance with the requirements of **Section 34, clauses 2 and 3.**

16. **Vessels carrying Oil Fuel in Double Bottom.**—The modifications required in the scantlings and arrangements of double bottoms for the carriage of oil fuel are contained in **Section 20, Sub-Sections C and D.**

ADDITIONAL STRENGTHENING OF THE FORE PART OF THE BOTTOM.

Section 11. 1. **Double Frames.**—(*a*) The frames are to be doubled from the half length forward to the statutory position of the collision bulkhead, from margin plate to margin plate of double bottoms, or to the lower turn of bilges where a double bottom is not fitted.

(*b*) Instead of the double bars required by the previous paragraph, single bars may be fitted having flanges each of sufficient breadth to take two complete rows of rivets.

2. **Shell Plating.**—The thickness of the three strakes of shell plating next the keel is to be 10 per cent in excess of the midship thickness, and this is to be maintained from half length forward to the position of the collision bulkhead as defined by the Rules. In small vessels two strakes only need have this increased thickness if these cover entirely the flat of bottom.

3. **Side Girders.**—(*a*) In vessels having double bottoms the spacing of the intercostal girders forward of the half length is not to exceed 7 feet, and additional intercostal girders attached to the shell and having a height of one-half the depth of the floor at that part are to be fitted extending as far forward as practicable.

(*b*) Where there is no double bottom in the fore part of a vessel, additional intercostal side keelsons are to be fitted from the half length to the position of the collision bulkhead specified in the Rules.

4. **Riveting.**—Forward of the half length, the rivets connecting the frames to the floors and plating in the bottom of vessels are to be spaced $5\frac{1}{2}$ diameters apart, centre to centre.

The seams of the shell plating are, in all cases, to be double riveted.

5. **Flanging.**—Floor plates or intercostals are not to be flanged within the range of the strengthening required by this section.

SHELL PLATING.

Section 12. 1. **Thickness.**—(*a*) The thickness of the shell plating is given in Tables 18 and 19 and the reduction towards the ends of the vessel is to be effected gradually.

(*b*) The strakes of shell plating next the keel are to have the thickness maintained forward as required by **Section 11, clause 2.**

(*c*) In single screw steamers the plates connected to the sternframe, and in twin screw steamers the plates connected to the spectacle frame and to the sternframe, are to be of the Table thickness required for the side plating amidships. Plates on the spectacle frame of twin screw steamers, and on the boss of single screw steamers, which require to be furnaced are to have the thickness required for propeller boss plates given in **Tables 18 and 19.** The shell plating is to be of increased thickness or doubled in the region of the hawse pipes.

(*d*) In way of long bridges the thickness of the upper deck sheerstrake and strake below may be as required for side plating.

(*e*) Where the breadth of the strakes of shell plating is excessive suitable compensation will be required.

2. **Shift of Butts.**—(*a*) The butts of shell plating are to be arranged to give as good a shift as possible and in adjoining strakes butts are not to be nearer each other than two frame spaces. Butts of alternate strakes, other than the strakes adjacent to flat plate keels, are not to be in the same frame space.

(*b*) The butts of the sheerstrakes are to be shifted at least two frame spaces from the butts of adjacent deck stringer plates.

3. **Fitting and Caulking of Butts and Edges.**—All outside edges of seams and butts are to be either planed or chipped fair and then carefully caulked.

Plates are to be sheared from the faying surface and if this be not done the burr caused by shearing is to be carefully removed.

4. **Openings in Topside Plating.**—(*a*) Where sidelight or other openings are cut in the sheerstrake, and the sectional area removed is greater than 20 per cent of the unpierced plate, compensation is to be provided by increasing the thickness of the plating.

(*b*) All openings in the shell plating for cargo doors, coal ports, and other purposes, are to have well-rounded corners, and arrangements are to be made to maintain the transverse and longitudinal strength in way of the openings.

5. Liners.—The spaces between plating and frames are to be closely fitted with liners of iron or steel which are to be in one piece and of the same breadth as the flange of the frame.

6. Bulwark Plating.—(*a*) The spacing between the stanchions which support the bulwarks is not to exceed 6 feet. The stanchions nearest the ends of a bridge or long poop are not to be more than 5 feet from the bridge or poop bulkhead, and are to be formed of web plates. Where the bulwark plating and main rail are cut to form a gangway or cargo port, the bulwark stays at each end of the port are to be of increased strength.

(*b*) Care is to be exercised that continuity of strength is maintained at the break of erections ; and gangways, doors and other openings in the bulwark plating are to be kept well clear of these breaks. Where mooring pipes are fitted in bulwarks, the surrounding plating is to be doubled.

DECKS.

Section 13. 1. Steel Decks.—(*a*) Steel decks are to be fitted in accordance with the requirements of Tables 20 to 26.

(*b*) The scantlings of upper, second and third decks in association with beams on every frame are to be in accordance with the requirements of Tables 20, 21 and 26. The scantlings for upper decks given in Tables 20 and 21 headed "Where One Deck is Fitted," apply to the upper decks of vessels having no decks below. The heading "Where Two Decks are Fitted" refers, as indicated by the sub-headings in the Tables, to the cases where the second deck is composed of stringers and tie plates or is a complete steel deck, and the heading "Where Three Decks are Fitted" refers to vessels which have three complete steel decks.

(*c*) The thicknesses given in the Tables are associated with a tumble-home of 12 inches at the strength deck. If the tumble-home is greater or less than 12 inches the thickness of the deck plating is to be increased or may be reduced to provide the same sectional area of material. The deck plating is not, however, to be less in thickness than required by Tables 20 to 23.

(*d*) The thicknesses given in the Tables are those required to be fitted abreast the deck openings, which are taken to be 40 per cent of the breadth of deck amidships in the upper and second decks, and 50 per cent in the third deck. If the width of the openings on the strength deck is greater or less than specified above, the thickness of the deck plating is to be increased or may be reduced to provide the same sectional area of material ; and at lower decks, if the width of the openings is greater than specified, the thickness of the plating is to be increased. The deck plating is not, however, to be less in thickness than required by Tables 20 to 23.

(*e*) The thicknesses given in Table 20 are applicable to flush deck full scantling vessels. In vessels having superstructures the thickness of the deck stringer and plating is to be increased as provided in the Table in proportion to the total percentage length of superstructures fitted.

(*f*) Between the deck openings on the upper and second decks the thickness of the deck plating may be reduced within the line of the hatchway side coamings to that given in the Tables. At decks below the second deck, the thickness of the plating within the line of the hatchway side coamings may be as given in Table 26 for deck plating at ends.

(*g*) Within a partial superstructure exceeding 15 per cent of the vessel's length the thickness of the upper deck may be as required by the Tables for a second deck, and the thickness of the second deck may be as required for a third deck.

(*h*) Where there is indication of particular concentration of loading the Committee may require additional strengthening to be fitted to the decks.

(*i*) Where the beams at unsheathed steel decks required by the Rules are not fitted at every frame, the thickness of the plating is not to be less than ·36 inch where the spacing of the beams is 44 inches, ·40 inch where the spacing of the beams is 54 inches, and ·44 inch where the spacing of the beams is 60 inches. At the sides of deck openings the thickness of the plating is not to be less than ·44 inch and this thickness is not to be reduced at the ends.

(*j*) Where the height of 'tween decks exceeds 8 feet 6 inches the thickness of the strength deck is to be increased.

(*k*) All steel decks are to be caulked, unless sheathed with a properly caulked wood deck.

(*l*) Where the length of either the engine or boiler room opening exceeds 15 feet or the combined length exceeds 30 feet, the deck abreast the openings is to be completely plated over. The plating is to extend two frame spaces beyond the opening, and is to be tapered thence to the stringer plate over a distance equal to the breadth of the plating required to be fitted.

2. **Stringer Plates.**—(*a*) Stringer plates of the dimensions given in Tables 20 to 26 are to be fitted on the decks indicated. Deck stringer plates are to maintain the midship breadth and thickness for one-half the vessel's length amidships, and they are to be gradually reduced to the scantlings given for stringer plates at the ends of the vessel.

(*b*) Within a partial superstructure the thickness of the stringer plates may be modified in the same manner as permitted for deck plating.

(*c*) The stringer plates on all decks are to be connected to the shell plating with angle bars of the size required by Tables 24 to 26.

(*d*) The stringer plates of decks below the weather deck are to have an angle bar, 3 inches by 3 inches, of the same thickness as the stringer plate fitted inside the frames. The thickness of this bar need not exceed ·50 inch. The space between this angle bar and the shell plating is to be filled in with cement.

3. **Tie-plates.**—(*a*) Where steel decks are not laid, continuous tie-plates of the size given in the Tables are to be fitted on the beams upon each side of the hatchways, and tie-plates are to be riveted to the hatch end beams in order that the ends of the wood deck may be properly fastened.

(*b*) Where hatchways exceed normal breadth the deck is to be plated between the hatchway sides and the stringer plate.

(*c*) Where widely spaced pillars with girders are fitted, the scantlings of the tie-plates are to be increased.

4. **Minimum requirements for Steel Decks.**—(*a*) Unsheathed steel lower decks which are additional to those required by the Rules or for which credit is not taken in ascertaining the thickness of the upper deck are to have a thickness not less than ·30 inch where beams are fitted on every frame and not less than ·34 inch where beams are fitted on alternate frames. Where these decks are sheathed the thickness may be ·28 inch where beams are fitted on every frame and ·30 inch where beams are fitted on alternate frames.

(*b*) Unsheathed steel upper or bridge decks in vessels which do not require a steel deck by Tables 20 and 21 are not to be less in thickness than ·28 inch for vessels 100 feet long and ·30 inch for vessels 200 feet in length where beams are fitted on every frame.

(*c*) The thickness of the stringer plate is to be ·04 inch greater than the thickness of the plating.

5. **Continuity of Strength.**—(*a*) Care is to be taken to preserve the continuity of strength at hatchways, at engine and boiler room openings and other openings and at deckhouses. For this purpose intercostal girders should be fitted below the uppermost deck and should be efficiently connected to the various coamings and casings by laps or brackets, or may be arranged to overlap in a satisfactory manner. The requirements at ends of superstructures are set forth in Section 22, clause 4.

(*b*) Doubling plates are to be fitted round the corners of all large openings in the strength deck plating. At the deck next below the strength deck doublings or long overlaps of the deck plating are to be fitted at the corners of the openings.

6. **Wood Decks.**—(*a*) The material employed is to be of good quality, properly seasoned, and free from sap, shakes and objectionable knots.

(*b*) The thickness of the deck is not to be less than $2\frac{1}{2}$ inches of pine or 2 inches of teak in vessels not exceeding 150 feet in length, and 3 inches and $2\frac{1}{2}$ inches for pine and teak respectively in vessels of greater length.

(*c*) Where gutter waterways are fitted at the weather deck, the angle bar forming the inner edge of the waterway is not to be less in thickness than ·36 inch.

(*d*) Thwartships planks are to be laid at the end coamings of all hatchways and deckhouses.

(*e*) The width of kauri, oregon and pitch pine planks should not exceed 5 inches, and the oregon pine should be laid with the grain vertical.

(*f*) Where deck planks are 6 inches in width or under, a single fastening will be accepted, but where the width exceeds 6 inches, two bolts are required for each plank at every beam.

The bolts are to be galvanised, nuts fitted on the under side, and properly sunk with oakum and white lead under their heads and be carefully covered over with turned dowels bedded in white lead, marine glue, or other suitable composition. Pine decks not exceeding 3 inches and teak decks not exceeding $2\frac{1}{2}$ inches in thickness are to be fastened by bolts $\frac{1}{2}$ inch in diameter; planks of greater thickness are to be fastened by bolts $\frac{5}{8}$ inch in diameter.

(*g*) All decks are to be efficiently caulked and payed.

(*h*) The requirements for wood decks in sailing ships are given in Section 35, clause 6.

7. **Wood Sheathing.**—Where wood sheathing is laid over a steel deck, the thickness need not exceed $2\frac{1}{2}$ inches of pine, or 2 inches if of teak. The planking is to be efficiently secured to the deck plating between the beams, and the wood deck is to be efficiently caulked and payed.

8. Deck Compositions.—Where owners desire to use compositions as substitutes for wood sheathing on steel decks, these decks are to be caulked and made watertight prior to the substitute being applied.

If the chemical composition of the material is such that there is a possibility of corrosive action taking place between it and the steel, the steel deck is to be coated with an approved insulating material.

9. Water Testing.—Weather decks and gutterways on completion are to be water tested by hose.

INCREASED FRAME SPACING.

Section 14. 1. Increased Frame Spacing.—(*a*) Where a spacing of frames greater than that given in the Tables is desired, the scantlings of the various parts of the structure are to be increased as specified in this Section. Where this increase in spacing exceeds 9 inches, special consideration of the scantlings and arrangements will be given.

(*b*) The frame spacing is not to exceed 27 inches between the collision bulkhead and one-fifth the vessel's length from forward, and in the peaks the spacing is not to exceed 24 inches.

2. Double Bottom.—(*a*) The thickness of the floor plates and tank side brackets is to be increased at the rate of ·02 inch for every 3 inches increase in spacing. The floors may be stiffened by vertical bars between the intercostal side girders instead of being increased in thickness.

(*b*) The thickness of the inner bottom plating in the holds and the tank margin plate throughout are to be increased at the rate of ·02 inch for every 4 inches increase in spacing, and the increase in the thickness of the inner bottom plating in the engine room is to be ·02 inch for every 6 inches increase in spacing. The thickness of the middle line strake need not be increased but is not to be less than the remainder of the plating.

(*c*) Where bracket floors are fitted in the double bottom, the scantlings of the frames and reversed frames are to be increased to give equivalent strength to that required by the Tables. The thickness of the bracket plates is to be the same as that of the floor plates as increased.

(*d*) The thicknesses of the material in the boiler room are to be increased by one-half the amount of the increase required in the holds.

3. Side Framing.—(*a*) The scantlings of the side framing in the holds and 'tween decks are to be increased so as to give equivalent strength and stiffness to the requirements of the Tables.

(*b*) All frames are to be extended to the superstructure deck where such is fitted.

4. Shell Plating.—The thickness of the bottom and side shell plating is to be increased at the rate of ·02 inch for every 2 inches increase in spacing. The thickness of the sheer-strake and strake below need not be increased, but is to be at least equal to the increased thickness of side shell plating.

5. Deck Beams.—The scantlings of the beams and beam knees are to be increased to give equivalent strength to the requirements of the Tables.

6. Pillars.—The scantlings of closely spaced pillars and of the corresponding runners under the deck beams are to be increased to give equivalent strength to that required by the Tables.

7. Deck Plating.—(*a*) The thickness of the plating of the strength deck abreast the openings will not, in general, require to be increased with increase of frame spacing. Where, however, the thickness of the plating is less than that given below, it is to be increased ·02 inch for every 4 inches increase in spacing until these thicknesses are reached.

Length of Vessel.	Increased Frame Spacing.	Thickness of Strength Deck Plating abreast Openings.
Feet.	Inches.	Inch.
250	30	·36
300	30	·38
300	36	·42
400	36	·50
500	36	·60

(*b*) The thickness of the second and third decks is to be increased ·02 inch where a spacing increased to 36 inches is adopted. This increase does not apply to the stringer plates.

(*c*) The thickness of the plating between deck openings need not be increased with increase of frame spacing.

(*d*) No increase will be required to the thickness of decks which are sheathed with wood.

8. Middle Line Bulkhead.—Where a middle line bulkhead is fitted the spacing of the stiffeners is not to exceed 60 inches, and the scantlings of the stiffeners are to be in accordance with the spacing adopted.

9. **Riveting.**—(*a*) The diameter of the rivets and the number of rows of rivets are to be governed by the thickness of plating required at the Rule frame spacing.

(*b*) The spacing of the rivets is to be determined by **Table 38.**

(*c*) Where the Rule frame spacing is below 28½ inches and the increase in frame spacing exceeds 3 inches, the spacing of the rivets connecting the side frames to the shell plating is to be reduced by one-half of a diameter.

(*d*) The riveted attachment of the tank side brackets to the margin plate and to the main frames is to be increased in respect of the increased spacing adopted.

10. **General.**—In cases in which increased frame spacing is adopted, such local increases in scantlings are to be made as may be considered necessary.

BEAMS.

Section 15. 1. **Scantlings.**—(*a*) The scantlings of the beams at the various decks are set forth in **Tables 12** and **13.** Where the beam spacing is different from that shown in the Tables the scantlings of the beams are to be suitably modified.

(*b*) Where the beams between one-fifth of the vessel's length from forward and the collision bulkhead are spaced more closely than required by **Tables 12** and **13,** they may be reduced so as to give equivalent strength to the requirements of the Tables.

(*c*) The sizes of the half beams are to be determined by the breadth of the deck amidships in conjunction with the greatest length of unsupported beam abreast openings, and are to be obtained by interpolation from the sizes given in **Tables 12** and **13** for beams supported by one, two and three rows of pillars.

(*d*) The scantlings given in the Tables are applicable to a 'tween deck height of 8 feet 6 inches, and when this height is exceeded, the strength of the beams is to be increased in proportion to the increased height of 'tween decks.

(*e*) The beams of decks fitted exclusively for the accommodation of passengers may be of the size given for the beams of long bridge decks.

(*f*) Where cargoes such as chilled beef are suspended from the beams of decks, which may, at the same time, be loaded above, the strength of the beams of cargo decks is to be increased 33 per cent where one tier of quarters is carried, 66 per cent where two tiers, and 100 per cent where three tiers are carried.

In the case of weather deck beams, this increase is to be 50 per cent for one tier, and 100 per cent for two tiers, but the scantlings of these beams need not exceed those of cargo beams which have been increased for the same purpose.

(*g*) Through beams with plating are to be fitted in the machinery space at the level of each deck wherever possible, but where this is impracticable, strong beams are to be fitted.

(*h*) Where the hatchway side coamings and end beams are reinforced to compensate for the omission of side and corner pillars, the scantlings of the hatchway end beams are to be as required by **Section 16.**

(*i*) Where the line of pillars at the sides of hatchways is more than 18 inches from the coamings, the overhanging half beams will require to be efficiently reinforced or the coamings will require to be made sufficiently strong as a girder to support the deck loads.

(*j*) Beams on which a steel deck is not fitted are to have equivalent strength to the requirements of **Tables 12** and **13.**

(*k*) The breadth of the deck flange of the beam is to be suitable for the diameter of the rivets in the deck plating.

(*l*) The requirements for beams in sailing ships are given in **Section 35, clause 4.**

2. **Spacing.**—(*a*) Beams are to be fitted at every frame :—

(1) At all watertight flats,

(2) At upper decks of all single deck vessels above 15 feet in depth,

(3) At unsheathed strength decks,

(4) At all decks where the frame spacing exceeds 30 inches.

(*b*) The beams of upper decks in way of poops, forecastles and bridges may be fitted at alternate frames, provided that for eight frame spaces within each end of the bridge, the beams are fitted at every frame.

(*c*) The beams of the various decks are to be placed over each other and, as far as practicable, are to be fitted to the frames which have reversed angles extended to the upper deck.

3. Beam Knees.—(*a*) Beams need not overlap the frames.

(*b*) The depths of beam knees are to be measured from the top of beam at side.

(*c*) The depths of beam knees are to be three times the depths of the beams given in the Tables, whether at every frame or at alternate frames.

(*d*) Where the size of the beams has been modified either for an alteration of frame spacing or of 'tween deck height or to suit special conditions of loading or support, the depth of the beam knees is to be three times the depth of the beam of bulb angle section required and the number of rivets in each arm of the knee is to be governed by the actual depth.

(*e*) The depths of the beam knees at the upper deck in vessels which have not a tier of beams below, and at the second deck in two-deck vessels where the hold frames are cut or scarphed at the second deck, are to be as required by paragraphs (*c*) and (*d*), or as given in the following Table, whichever is the greater.

The thickness of these knees is to be in accordance with **Tables 12 and 13**, or as given in the following Table for the depth of knee to be fitted, whichever is the greater.

The beam knees required by this paragraph are to be maintained throughout.

* Depth of Rule Angle, Bulb Angle or Channel Frame.	Beam Knees.		* Depth of Rule Frame formed of Channel and Reversed Angle.	Beam Knees.	
	Depth.	Minimum Thickness.		Depth.	Minimum Thickness.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
5 or less	15	·32	13	44	·46 Fl.
7	21	·38	14	47	·46 Fl.
9	26	·44	15	50	·48 Fl.
11	31	·48			
13	36	·42 Fl.			
15	41	·44 Fl.			

* After correction for frame spacing if required.
For intermediate depths of Rule Frames the beam knees are to be obtained by interpolation.

(*f*) Where the intermediate frames in 'tween decks are omitted beam knees of ordinary dimensions are to be fitted, and the number and spacing of rivets in each flange of the angle lugs connecting the knees to the side plating are to be the same as the number and spacing of those attaching them to the beam.

(*g*) The thickness of beam knees is to be in accordance with the requirements of **Tables 12 and 13.**

(*h*) Knees 36 inches and above in depth are to be flanged on their inner edge.

Where the beam knees are flanged, the thickness may be reduced 20 per cent.

The breadth of the flange is not to be less than 2 inches in brackets not exceeding 24 inches in depth; $2\frac{1}{2}$ inches in brackets above 24 inches and not exceeding 36 inches in depth; 3 inches in brackets above 36 inches and not exceeding 44 inches in depth; and $3\frac{1}{2}$ inches in brackets exceeding 44 inches in depth.

(*i*) The number and size of the rivets in both arms of beam knees are to be as given in the following Table:—

Depth of Knee Measured from Deck.	Breadth of Knee Measured from End of Beam.	Number of Rivets.	Diameter of Rivets.
Inches.	Inches.		Inches.
14	10	4	$\frac{5}{8}$
17	12	4	$\frac{3}{4}$
21	15	5	$\frac{3}{4}$
24	17	5	$\frac{7}{8}$
28	21	6	$\frac{7}{8}$
32	24	7	$\frac{7}{8}$
36	27	8	$\frac{7}{8}$
40	31	9	$\frac{7}{8}$
44	35	10	$\frac{7}{8}$
48	39	11	$\frac{7}{8}$
52	43	12	$\frac{7}{8}$

(*j*) Half beams fitted to alternate frames are to be connected to the coaming plates with double angles; half beams fitted to every frame may be connected to the coaming plates with single angles of not less thickness than the side coaming plates. There are to be two rivets in each flange of the angles connecting coamings to the half beams where the depth of the half beam is 8 inches, three in beams $8\frac{1}{2}$ inches to $11\frac{1}{2}$ inches in depth, and four rivets where the depth is 12 inches.

4. Rows of Pillars.—(*a*) The numbers of rows of pillars are determined in association with the scantlings of the beams and are to comply with the requirements of **Tables 14 and 15.**

(*b*) Beams at the ends of the vessel are to be equivalent in strength and stiffness to the beams amidships having regard to the span, and the scantlings may be obtained by interpolation between columns 1, 2 and 3 of Tables 12 and 13.

PILLARS AND GIRDERS.

Section 16. 1. **General.**—All beams are to be supported either by closely spaced pillars or by widely spaced pillars in association with longitudinal girders under the decks. Pillars in 'tween decks and holds are to be fitted in the same vertical line.

2. **Closely Spaced Pillars.**—(*a*) Closely spaced pillars, which may be of either iron or steel, are to be fitted at alternate frames in accordance with the requirements of Table 14.

(*b*) In way of poops, bridges, and forecastles, the scantlings of the pillars under each deck are to be as required by the Table for the deck next below.

(*c*) Where beams are fitted at every frame, pillars are to be attached at their heads to continuous fore and aft girders of double angles having the scantlings given in Table 14. The girders are to be attached to each beam and to the bulkheads by angle lugs.

(*d*) The heels of pillars at inner bottoms and at tops of deep ballast tanks are to be fitted and riveted to double angle bars or tee bars.

(*e*) The heads and heels of all pillars are to have a bearing fit.

(*f*) Pillars which support decks intended exclusively for the accommodation of passengers may be $\frac{1}{8}$th inch less in diameter than required by the Table where the diameter is 3 inches, $\frac{1}{4}$ inch less where the diameter is 4 inches, and $\frac{1}{2}$ inch less where the diameter is greater than 4 inches.

(*g*) Additional pillars are to be fitted to the beams below deckhouses, windlass, steam winches and capstans, and otherwise where considered necessary.

(*h*) Where double pillars are fitted for the purpose of securing shifting boards, their diameter is to be three-fourths the diameter required for single pillars.

(*i*) Where cargoes such as chilled meat are suspended from a deck which may at the same time be loaded above, the scantlings of the pillars are to be suitably increased.

(*j*) Where pillars are fitted on a shaft tunnel, the tunnel is to be additionally strengthened under the heels of the pillars if necessary.

(*k*) Pillars made of approved weldless rolled or drawn steel tubes may be of the diameter required by Table 14 for hollow pillars with a reduction of 25 per cent in thickness. The steel of which these tubes are made is to have a tensile strength of not less than 35 tons per square inch with an elongation of not less than 10 per cent in a length of 8 inches.

3. **Widely Spaced Pillars.**—(*a*) Where pillars are widely spaced, the scantlings are to comply with Table 15, and are to be determined on the basis of length of pillar in association with a numeral

$$\frac{S \times B \times H}{100}$$

where S is the fore and aft distance, in feet, from centre of span to centre of span;

B is that proportion of the breadth of deck, in feet, supported by the pillars;

H is the sum of the heights of the several superimposed 'tween decks measured, in feet, from top of beam to top of beam with an addition of 5 feet for the upper deck in Full Scantling vessels, and 4 feet for upper decks in Complete Superstructure vessels and for poop, bridge and forecastle decks.

In the case of a deck fitted exclusively for the accommodation of passengers, the height of 'tween decks may be taken as 4 feet. For superimposed superstructures exclusively devoted to such accommodation this height may be taken as 3 feet in each case.

(*b*) The scantlings given in Table 15 are arranged for pillars made of steel having a tensile strength of from 26 to 32 tons per square inch. Where steel of 22 to 25 tons per square inch tensile strength is used, the thickness is to be increased 20 per cent beyond the requirements of the Table.

(*c*) In the 'tween decks widely spaced solid pillars, having the scantlings given in Table 15A, may be fitted. These pillars are to have flat palms at their heads and heels and are to be attached by rivets of the number and diameter given in the Table.

(*d*) Effective arrangements are to be made to distribute the support of the pillars to the decks and to distribute the load on the pillars at the heels.

Where non-symmetrical types of girders are fitted longitudinal and transverse supporting brackets are to be fitted in way of the heads of the pillars.

Where considered necessary by the Committee, the attachment of the floors to the intercostals and of the floors and intercostals to the inner bottom plating below the heels of pillars, will be required to have additional riveting.

Where pillars are not stepped on the tank top at the intersection of a floor and an intercostal girder, intercostals and partial solid floors are to be fitted. Manholes are not to be cut in the floors and intercostals below the heels of pillars.

(*e*) Doubling plates are to be fitted on the inner bottom plating under the heels of widely spaced tubular pillars.

For refrigerated vessels carrying oil fuel in double bottom *see* **Section 20C, clause 4.**

(*f*) Where cargoes such as chilled meat are suspended from a deck which may at the same time be loaded above, the scantlings of the pillars are to be suitably increased.

4. **Deck Girders at Heads of Widely Spaced Pillars.**—(*a*) Where widely spaced pillars are fitted, the beams between the pillars are to be supported by deck girders of the dimensions given in **Tables 16** and **17** and the scantlings of the girders are to be determined on the basis of the depth of girder in association with a numeral

$$\frac{S^2 \times B \times H}{100}$$

where S is the fore and aft spacing, in feet, of the pillars from centre to centre;

B is that proportion of the breadth of the deck, in feet, supported by the girder;

H is the height of the 'tween decks next above the girder, measured in feet, from top of beam to top of beam where the pillars in the 'tween decks are placed immediately over those below.

For upper decks in Full Scantling vessels H may be taken as 5 feet. For decks fitted exclusively for the accommodation of passengers and for upper decks in complete superstructure vessels and for poop, bridge and forecastle decks H may be taken as 4 feet.

For superimposed superstructures exclusively devoted to passenger accommodation this height may be taken as 3 feet.

Where the pillars above a deck are not placed over those below, H is to be the sum of the heights of the several 'tween decks, in feet, above the girder, with an addition as specified above for the weather deck, or, is to be increased to correspond with the additional load supported.

(*b*) Plates, channels, bulb angles and angles forming component parts of girders, are to be fitted in long lengths and are to be efficiently strapped or lapped at the butts.

(*c*) Where girders are formed of channels, these are to be attached by two rivets either to the lower flanges of the beams, or to short angle lugs fitted to the beams.

Where girders have double lower angles, the intercostal plates are to be attached to the beams by angle lugs extending to the bottom of the girder and to the bottom of the beams alternately where beams are fitted at every frame, and to the bottom of the girder at every beam where beams are fitted at alternate frames.

Where girders have single bulb angles on the lower edge, plate brackets supporting the girder are to be fitted not more than three frame spaces apart when the beams are on every frame, or two frame spaces apart when the beams are fitted on alternate frames, and where double bulb angle girders are fitted these brackets may be four frame spaces apart. At deck girders abreast hatchways the supporting brackets are not to be more than two frame spaces apart. The beams between these plate brackets are to be attached to the girders by angle lugs, which extend alternately to the bottom of the beam and to the bottom of the girder.

(*d*) Girders are to be efficiently attached to the bulkheads by flanged brackets having a depth equal to twice the depth of the girder measured from the top of the beam, and having the same thickness as the girder plate.

(*e*) Where cargoes such as chilled meat are suspended from a deck which may at the same time be loaded above, the scantlings of the girders are to be suitably increased.

5. **Reinforced Hatchway Side Coamings and End Beams in 'Tween Decks.**—(*a*) Where the hatchway side coamings of 'tween decks are designed to act as deck girders, the scantlings are to comply with **Table 17**, and the number to be used is given by

$$\frac{L^2 \times b \times H}{100}$$

where L is the length of hatchway in feet,

b is that proportion of the breadth of the deck, in feet, supported by the side coaming;

H is the height, in feet, of the 'tween decks next above the girder, measured as in **clause 4.**

(*b*) Where a hatchway side girder does not form part of a continuous fore and aft girder, it is to extend for a distance equal to two frame spaces beyond each end of the hatchway and is to be efficiently attached to the hatchway end beams by large gusset plates.

(*c*) Plate brackets are to be fitted not more than two frame spaces apart.

(*d*) Where the hatchway end beams which carry the hatchway side coamings are supported by pillars at the

centre line only, the scantlings are to comply with Table 17, and the numeral to be used is given by

$$\cdot 75 \times \frac{L \times b \times B \times H}{100}$$

where L, b, and H have the same meaning as in paragraph (*a*);

B is half the breadth of the deck in feet at the hatchway end beam.

(*e*) The hatch end beam knees are to be increased in breadth and thickness beyond the ordinary requirements and are to be flanged on the edge.

(*f*) The frames to which the hatchway end beams are attached are to be reinforced if considered necessary.

(*g*) In cases where deep hatchway side coamings and end beams are fitted, as at weather decks, the arrangements will be specially considered.

6. **Riveting.**—(*a*) The number of rivets in the heads and heels of solid or hollow closely spaced pillars is to be regulated by their diameter in accordance with the following Table :—

Diameter of Pillar.	Number of Rivets.	Diameter of Rivets.
Inches.		Inches.
Not exceeding $3\frac{1}{2}$...	2	$\frac{7}{8}$
Above $3\frac{1}{2}$ and not exceeding $4\frac{1}{2}$...	3	$\frac{7}{8}$
„ $4\frac{1}{2}$ „ „ „ 6 ...	4	1
„ 6	6	1

(*b*) Where pillars are fitted under watertight flats the rivet attachment is to be sufficient to withstand the load due to water pressure.

(*c*) The rivets in the seams of built tubular pillars are to be spaced not more than 5 diameters apart, centre to centre.

(*d*) The rivets in angles or channels forming pillars are to be spaced so as to close the work efficiently, and may be 7 diameters apart, centre to centre.

(*e*) The rivets in deck girders are to be spaced so as to close the work efficiently, and may be 7 diameters apart, centre to centre. The rivets in the intercostal angle are to be spaced not more than 5 diameters apart, centre to centre.

(*f*) The flanged brackets at the ends of the girders are to be double riveted to the girders and to the bulkheads.

7. **Machinery Spaces.**—(*a*) The beams in the machinery space are to be pillared as far as practicable.

(*b*) The requirements regarding the scantlings of bunker bulkheads which act as pillars are set forth in Section 21.

8. **Middle Line Bulkheads in lieu of Pillars.**—The requirements regarding the scantlings of non-watertight middle line bulkheads are set forth in Section 21.

WATERTIGHT BULKHEADS.

Section 17. 1. **Peak and Machinery Space Bulkheads.**—(*a*) A watertight collision bulkhead is to be fitted at a distance not less than 5 per cent of the vessel's length from the fore part of the stem at the waterline.

(*b*) An after peak bulkhead is to be fitted, and is to be arranged to enclose the shaft tubes in a watertight compartment.

(*c*) A bulkhead is to be fitted at each end of the machinery space.

2. **Additional Bulkheads.**—(*a*) Additional watertight bulkheads as follows are to be fitted at reasonable spacing :—

In vessels above 285 feet and not exceeding 335 feet in length, an additional watertight bulkhead is to be fitted about midway between the collision and boiler room bulkheads, making a total of five bulkheads.

In vessels above 335 feet and not exceeding 405 feet, two additional watertight bulkheads are to be fitted, one in the forward hold and one in the after hold, making a total of six bulkheads.

In vessels above 405 feet and not exceeding 470 feet, seven watertight bulkheads are to be fitted.

In vessels above 470 feet and not exceeding 540 feet, eight watertight bulkheads are to be fitted.

In vessels above 540 feet and not exceeding 610 feet, nine watertight bulkheads are to be fitted.

(*b*) Where in vessels above 220 feet and not exceeding 285 feet in length the machinery space is fitted aft, a watertight bulkhead is to be fitted about midway between the collision bulkhead and the bulkhead at the fore end of the engine and boiler space.

(*c*) In vessels in which the fitting of the number of bulkheads specified in the preceding paragraphs would interfere with the requirements of a special trade in which the vessel is to be employed, the Committee will be prepared to consider proposals from the Owner to dispense with one or more bulkheads. In all such cases suitable structural

compensation for the omission of the bulkhead will be required, and a notation will be made in the Register Book describing the number and position of the bulkheads omitted.

(*d*) For bulkheads in sailing vessels, see **Section 35.**

3. **Height of Bulkheads.**—(*a*) The collision bulkhead is to extend in all cases to the upper deck.

(*b*) In Full Scantling vessels the bulkheads are to extend to the upper deck, except the after peak bulkhead, which, subject to the approval of the Committee, may extend to the first deck above the load waterline, provided this deck forms a watertight flat from the bulkhead to the stern.

(*c*) In vessels whose draught does not exceed that which could be assigned as a Complete Superstructure vessel the bulkheads need extend to the second deck only.

(*d*) In all vessels the machinery openings within the superstructure are to be efficiently trunked.

4. **Bulkhead Plating.**—(*a*) The plating is to be not less in thickness than required by **Table 31.**

(*b*) The lowest strake is to be at least 36 inches in height, measured from the tank top, or from the keel in vessels having no double bottom, but where there is a double bottom on one side of the bulkhead only, the lowest strake is to extend at least 12 inches above the double bottom. In all cases the lowest strake is to be at least ·04 inch thicker, and in the case of a stokehold or bunker bulkhead this strake is to be ·10 inch thicker than required by the Table. Where the stokehold or bunker bulkhead forms the boundary of oil fuel tank the increase to the lowest strake need only be ·04 inch. At the end of a stokehold space the bottom plating of the bulkhead is to extend to a height not less than 24 inches above the stokehold floor.

(*c*) Plates in the limbers are to be ·10 inch thicker than required by the Table.

(*d*) The bulkhead plating is to be doubled or increased in thickness in way of the stern tube opening.

5. **Bulkhead Stiffeners.**—(*a*) Vertical stiffeners are to be fitted of the size required by **Tables 27** and 28, spaced 30 inches apart, but this spacing may be increased up to a maximum of 36 inches, provided the strength be correspondingly increased.

The scantlings of stiffeners which are bracketed at one end and lugged at the other may be taken as a mean between those required by **Tables 27** and 28.

(*b*) The spacing of stiffeners of collision bulkheads is not to exceed 24 inches, but the scantlings of stiffeners and thickness of plating are to be as required by **Tables 27, 28** and 31 for stiffeners spaced 30 inches apart.

(*c*) The lower end of each stiffener is to be attached to the shell plating, or to the inner bottom plating, and the bracket, or its connecting angle, is to extend to the floor adjacent to the bulkhead.

At each deck level which forms the top of a system of stiffeners, plating is to be provided of a character which will ensure horizontal rigidity in the bulkhead, and the upper brackets on the stiffeners are to be connected to angles which extend over a beam space, when beams are fitted either at every frame or at alternate frames. In the latter case the vertical flanges of the angles are to be increased in depth by 1 inch. Other effective means may be adopted for securing the necessary structural rigidity in these parts.

The distance from the heel of the boundary bar to the extremities of the arms of the brackets is to be two and one-half times the depth of the stiffener and the thickness of the brackets and number of rivets in each arm is to be as required by **Table 30.**

(*d*) Where bulkhead stiffeners are cut in way of watertight doors in the lower part of a bulkhead, the opening is to be suitably framed, and a tapered web plate, stiffened on its edge, is to be fitted on each side of the door from the base of the bulkhead to well above the door opening.

Where stiffeners are not cut, but where the space between the stiffeners has to be increased on account of watertight doors in 'tween deck bulkheads, the stiffeners at the sides of the doorway are to be suitably increased in depth and strength so that the efficiency in this neighbourhood is at least equal to that of the unpierced bulkhead, without taking the stiffness of the door frame into consideration.

(*e*) Bulkheads are to be suitably strengthened at the ends of decks girders and where subjected to concentrated deck loads if necessary.

6. **Boundary Angles.**—The bulkheads are to be attached to the outside plating, decks, and inner bottom by single angles, not less than ·10 inch thicker than the tabular thickness of the bulkhead plating to which they are attached. These angles may be single riveted, except where situated more than 35 feet below the top of the bulkhead, when they are to be double riveted in both flanges.

7. **Riveting.**—The rivets in the seams and butts of plating and in the boundary bars of bulkheads are to be spaced as required by Table 38. Where the distance below the bulkhead deck is more than 35 feet, the vertical connections of plates are to be double riveted. The rivets connecting stiffeners to bulkhead plating are to be spaced not more than 7 diameters, centre to centre, and, in the case of stiffeners having no bracket attachment they are to be spaced 4 diameters apart for 15 per cent of their length from each end.

8. **Caulking and Watertightness.**—All watertight bulkheads are to be carefully caulked, and their watertightness tested in accordance with clause 13.

In way of watertight flats the side framing is to be cut and bracketed to the deck, or watertightness is to be maintained by means of caulked angle chocks, or by cast steel or iron chocks efficiently secured and rust jointed.

9. **Watertight Recesses, Decks and Steps in Bulkheads.**—(*a*) Watertight recesses in bulkheads are to be framed and stiffened so as to provide equivalent strength and stiffness to watertight bulkheads.

(*b*) Watertight decks and steps in bulkheads are to have beams at every frame of the sizes given for stiffeners in Table 28, except where such beams are fitted in short lengths bracketed at each end, when they may be based on Table 27.

The horizontal plating is to be ·04 inch thicker than required for bulkheads under the same height from the top of the bulkhead or from the upper deck. In obtaining the necessary scantlings for beams and plating, account is to be taken of the spacing of the beams, and in no case are the sizes of these beams and thickness of plating to be less than required by Sections 15 and 13 respectively of the Rules.

(*c*) The rivet connections of pillars are to be sufficient to withstand the load due to water pressure.

10. **Chain Lockers.**—Where chain lockers are fitted abaft the collision bulkhead, the bulkheads are to be caulked.

11. **Watertight Longitudinal Bulkheads.**—Watertight longitudinal bulkheads are to be equal in strength and stiffness to transverse bulkheads of the same depth.

12. **Watertight Doors.**—(*a*) Watertight doors are to be carefully and efficiently constructed and fitted, and strongly connected to the bulkhead, and are to be hose tested in place. Provision should be made to ensure that coal will not impede the satisfactory operation of bunker doors.

(*b*) Watertight doors are to be capable of being quickly closed from an accessible position above the bulkhead deck, and are to have an index at the operating position showing whether the door is open or closed. Hand gear is to have an all-round motion. The lead of shafting is to be as direct as possible, and the screw is to work in a gunmetal nut.

(*c*) Hinged watertight doors of approved pattern may be fitted in 'tween decks in approved positions. The hinges to these doors are to be fitted with gun-metal pins.

13. **Testing.**—(*a*) On completion, ordinary watertight bulkheads and deck flats are to be hose tested to the Surveyor's satisfaction.

(*b*) Fore and aft peak bulkheads which do not form the boundaries of ballast tanks are to be tested by the peaks being filled with water to a height of not less than the load waterline.

14. **Deep Tanks and Tunnels.**—The requirements for the construction of deep tanks and peak tanks are contained in Section 19 and those for shaft tunnels in Section 18.

SHAFT TUNNELS.

Section 18. 1. **Tunnel.**—Where the engines are situated amidships, the shafting is to be enclosed in a watertight tunnel of dimensions which permit reasonable access for examination or repair of the shafting.

2. **Stiffeners.**—(*a*) Tunnel stiffeners are to be of the size required by Table 32 and are to be spaced 36 inches apart. The spacing of the stiffeners may be adjusted to suit the frame spacing provided an arrangement equivalent to the Rule requirements is obtained. The foot of each stiffener is to overlap and is to be attached in all cases to the tunnel base angle, which angle is to be ·10 inch thicker than the tunnel side plating. Angle stiffeners 6 inches in depth and all bulb angle stiffeners are to be connected to the inner bottom plating by a lug.

(*b*) Where the shaft tunnel passes through a deep tank the construction is to comply with the requirements of Section 19, clause 5.

(*c*) Additional stiffening as may be necessary is to be provided where masts or hold pillars are stepped on the tunnel.

3. **Plating.**—The plating on the flat of tunnel sides is to be of the thickness required by Table 31 for bulkhead plating with stiffeners spaced 36 inches apart, and the curved plating may be of the thickness required for bulkhead

plating with stiffeners spaced 30 inches apart. Where the spacing of the stiffeners exceeds 36 inches the thickness of the plating is to be increased at the rate of ·04 inch for 6 inches increase in spacing.

The top plating in way of the hatchways is to be not less than ·10 inch thicker than the remaining plates, or is to be covered with wood not less than 2 inches thick secured by bands and angles so as not to have through fastenings in the tunnel plating.

4. **Tunnel Recess.**—The plating of the top of the tunnel recess is to comply with the requirements for bulkheads. The scantlings of the beams are to be determined on the basis of their unsupported span, in conjunction with the height of cargo which they may be called upon to support, but should not be less than required for watertight flats by Section 17, clause 9.

The rivet connections of the pillars supporting the beams are to be sufficient to withstand the load due to water pressure.

5. **Riveting.**—Riveting and caulking are to be as required for ordinary watertight bulkheads.

6. **Entrance Door.**—The tunnel is to be provided with a watertight door on the engine room bulkhead fitted in accordance with the requirements of Section 17, clause 12.

7. **Pipe Tunnel.**—If a pipe tunnel is led through the forward holds, the scantlings and arrangements are to be similar to those required for a shaft tunnel.

8. **Ventilators.**—Ventilators to tunnels are to have scantlings suitable for the pressure to which they may be subjected, and are to be made watertight.

9. **Testing.**—On completion, tunnels are to be hose tested to the Surveyor's satisfaction.

DEEP TANKS AND PEAK TANKS.

Section 19. 1. **Plating.**—The thickness of the plating of the boundary bulkheads is to be as required by Table 31 for watertight bulkhead plating with stiffeners spaced 30 inches apart. Where the height of the overflow pipe above the crown of the tank does not exceed 30 per cent of the depth of the tank, the thickness of each strake of the plating is to be governed by the depth below the top of the tank to the lower edge of strake. Where the height represented by 30 per cent is exceeded, the depth given above is to be increased by a distance equal to one-half the difference between the height to which the overflow pipe extends and the height represented by 30 per cent of the depth of the tank. In no case, however, is the thickness to be less than ·30 inch.

2. **Stiffeners.**—(*a*) The spacing of the stiffeners on the boundary bulkheads is not to exceed 24 inches.

(*b*) The stiffeners are to be of the scantlings required by Table 34, and are to be determined on the basis of the length of stiffener in association with the head H, measured from the crown of the tank to the top of the stiffener, which is zero where the distance in feet from the crown of the tank to the top of the overflow pipe does not exceed 30 per cent of the depth of the tank. Where the height represented by 30 per cent is exceeded, H is to be taken as one-half of the difference between the actual height to which the overflow pipe extends and the height represented by 30 per cent of the depth of the tank. The stiffeners are to be bracketed at the deck and inner bottom. The sizes of the brackets and the number of rivets are to be as required for watertight bulkhead stiffeners of the same size.

3. **Deck.**—(*a*) The beams are to be fitted on every frame with scantlings in accordance with Table 12, but are to be not less in strength than required for the stiffeners of the boundary bulkheads. The beams are to be supported by an efficient intercostal girder on each side of the centre line, and special attention is to be paid to the riveting at the heads and heels of the quarter pillars.

(*b*) The deck plating forming the top of the tank is to be ·04 inch thicker than required for the boundary bulkheads under the same head, but is not to be less than ·34 inch with beams spaced 25 inches apart, ·40 inch with beams spaced 30 inches apart, and ·44 inch with beams spaced 36 inches apart, but the thickness of the plating is not to be less than required by Table 26. If the deck plating is sheathed the thickness is to be as required for the plating of boundary bulkheads, or as required by the Tables for deck plating, whichever of these is the greater.

4. **Framing.**—The side frames in deep tanks are to be increased half-an-inch in depth beyond the normal frame.

5. **Tunnel.**—(*a*) Where the shaft tunnel passes through a deep tank, the spacing of the stiffeners is to be the same as the frame spacing, and the scantlings are to be equivalent to those required by Table 34, and as provided in clause 2, the length of stiffener being taken as the height from the base of the tunnel to the top of the flat side. The ends of the stiffeners are to be bracketed to the inner bottom.

(*b*) The thickness of the plating is to be equivalent to that required for the boundary bulkheads of the deep tank, having regard to the spacing of the stiffeners in each case.

6. Washplates.—Efficient washplates are to be fitted at the middle line in peak tanks; they are also to be fitted in other water ballast tanks where the breadth exceeds 30 feet.

7. Boundary Angles.—The boundary angles of the bulkheads are to be single riveted where the depth of the tank does not exceed 35 feet. Where this depth is exceeded, the boundary angles are to be double riveted except at the deck, where they may be single riveted.

8. Air Pipes.—Air pipes are to be fitted at the opposite end to that at which the filling pipes are placed, or at the highest part of the tank. Their total sectional area is not to be less than the area of the filling pipes, and they are to be carried to above the upper deck. Openings of air pipes are to be provided with satisfactory arrangements to prevent the free entry of water. Ample provision is to be made for the free passage of air to prevent the formation of air pockets.

9. Ventilators.—'Tween deck ventilators to deep tanks are to have scantlings suitable for the pressure to which they may be subjected, and are to be made watertight.

10. Riveting.—The rivets in the seams and butts of the bulkhead plating and deck plating are to be spaced 4 diameters apart centre to centre. The rivets in the bulkhead flange of the boundary bar are to be spaced $4\frac{1}{2}$ diameters apart centre to centre, and in the shell, deck and inner bottom flange 5 diameters apart centre to centre. The rivets through the frames and shell plating are to be spaced $5\frac{1}{2}$ diameters apart, centre to centre, and the rivets attaching the stiffeners to the bulkhead plating are to be spaced 6 diameters apart, centre to centre.

11. Testing.—Tanks are to be tested by a head of water equal to 30 per cent of the depth of the tank, or 8 feet, whichever is the greater, provided the tanks are fitted with overflows or other means to prevent a greater pressure than the test head. Where the tanks are not fitted with overflows or other similar devices, they are to be tested by a head sufficient to give the maximum pressure which can be experienced in practice, but in no case less than 8 feet. In all cases the pressure to which the tanks will be subjected is to be indicated on the plans submitted for approval.

12. Bulkheads forming part of Watertight Subdivision.—Where the boundary bulkheads of the tank form part of the watertight subdivision of the vessel, the scantlings and arrangements of these bulkheads are not to be less than required by Section 17.

ARRANGEMENTS FOR CARRYING AND BURNING OF OIL USED AS FUEL.

A. GENERAL.

Section 20. 1. Flash Point.—(*a*) The following arrangements are applicable only to the cases where the oil fuel to be carried is such that its (close test) flash point, as determined by a standard type of flash point apparatus, does not fall below 150° Fahrenheit.

(*b*) For oil fuel with a lower flash point the arrangements are to be submitted for special consideration.

2. Record in Register Book.—In vessels arranged to use oil as fuel, and where the requirements of this Section have been complied with, the following records will be made in the Register Book:—"Fitted for oil fuel (date) F.P. above 150° F." in cases in which approval has been given for the use of oil with a flash point above 150° Fahrenheit. The notation "Fitted for low flash oil fuel" (date) will be made in cases where the arrangements have been approved for oil fuel with a lower flash point than 150° F.

B. OIL FUEL BUNKERS.

1. Plating.—The thickness of the plating of the boundary bulkheads is to be as required by Table 31 for watertight bulkheads with stiffeners spaced 30 inches apart. Where the height of the overflow pipes above the crown of the tank does not exceed 30 per cent of the depth of the tank, the thickness of each strake of the plating is to be governed by the depth below the top of the tank to the lower edge of strake. Where the height represented by 30 per cent is exceeded the depth given above is to be increased by a distance equal to one-half the difference between the height to which the overflow pipes extend and the height represented by 30 per cent of the depth of the tank. In no case, however, is the thickness to be less than ·30 inch.

2. Stiffeners.—(*a*) The spacing of the stiffeners on the boundary bulkheads is not to exceed 24 inches.

(*b*) The vertical stiffeners are to be as required by Table 34, and are to be determined on the basis of span between the horizontal supports in association with the head H, measured from the crown of the tank to the top of each span, where the distance, in feet, from the crown of the tank to the top of the overflow pipe does not exceed 30 per cent of the depth of the tank. Where this height is exceeded, H is to be increased by one-half the

difference between the actual height to which the overflow pipe extends, and the height represented by 30 per cent of the depth of the tank.

(*c*) The stiffeners are to be bracketed at the deck and inner bottom. The sizes of the brackets and the number of rivets are to be as required for watertight bulkhead stiffeners of the same scantlings.

(*d*) The vertical stiffeners on the boundary bulkheads and the side framing are to be supported by horizontal girders spaced about 8 feet apart. The scantlings of these girders are to be as required by Table 33 and are to be determined by a numeral

$$\frac{S^2 \times D \times H}{100}$$

where S = overall length of girder, in feet.

i.e., S is the distance between the boundary bulkhead when the horizontal girders are all fitted within the compartment. Where the girders are not all fitted within the compartment, S is to be increased in proportion to the increased span.

D = one-half the depth of the tank, in feet, where one horizontal girder is fitted.

= one-third the depth of the tank, in feet, where two horizontal girders are fitted.

= one-fourth the depth of the tank, in feet, where three horizontal girders are fitted.

H = the distance, in feet, from the crown of the tank to the horizontal girder where the height of the overflow pipe above the crown of the tank does not exceed 30 per cent of the depth of the tank. Where this height is exceeded, H is to be increased by a distance equal to one-half of the difference between the actual height to which the overflow pipe extends and the height represented by 30 per cent of the depth of the tank.

(*e*) The horizontal girders supporting the vertical stiffeners of the boundary bulkheads and the side framing are to be attached at their ends by flanged brackets. The toe of the bracket is not to be nearer the shell plating or the bulkhead plating than a distance equal to twice the breadth of the wider girder. The brackets are also to be double riveted in each arm.

Supporting bracket plates to the girders are to be fitted on every third stiffener or frame; the remaining stiffeners and frames are to be attached to the girders by angle lugs.

The girders are also to have supporting brackets at their intersection.

(*f*) In tanks which extend for the full breadth of the ship and which exceed 30 feet in length, the strength and stiffness of the horizontal girders are to be increased in proportion to the increased length of tank, and efficient transverse wash plate divisions may also require to be fitted if considered necessary.

(*g*) Where a steel deck abuts on an oil bunker bulkhead, the deck plating is to be attached to the bulkhead either by double angles, single riveted, or by tee bars.

3. **Tunnel.**—Where a tunnel passes through an oil fuel tank the scantlings are to be as required for a tunnel in a deep water ballast tank, but the angles attaching the tunnel plating to the inner bottom are to be double riveted.

4. **Middle Line Bulkhead and Washplates.**—(*a*) In tanks extending the full breadth of the ship a middle line bulkhead is to be fitted. Where this bulkhead is intact the construction is to be as required for the boundary bulkheads. If desired, this bulkhead may be perforated provided the total area of the openings does not exceed 10 per cent of the area of the bulkhead, in which case the horizontal girders may be dispensed with and vertical stiffeners of reduced size fitted.

(*b*) In tanks which extend for the full breadth of the ship, quarter washplates are to be fitted.

5. **Decks.**—(*a*) The beams are to be fitted on every frame with scantlings in accordance with Table 12, but are to be not less in strength than required for the stiffeners of the boundary bulkheads.

(*b*) The deck plating is to be as required for the crowns of deep water ballast tanks.

6. **Riveting.**—(*a*) Where the riveting is not otherwise required to be increased the seams and butts of the bulkhead, deck, tunnel and shell plating and the stringer angle may be single riveted if not more than 28 feet below the top of the overflow or 16 feet below the top of the tank : elsewhere the riveting is to be double. The boundary angles of the bulkheads are to be double riveted throughout.

The rivets in the plating of the boundary bulkheads, deck plating, inner bottom and deck stringer angle are to be spaced four diameters apart. The rivets in the boundary angles of the bulkheads may be spaced five diameters apart.

(*b*) The riveted connection of the horizontal girders to the bulkheads and shell plating may be by single angles, except at the ends of the girder, where they are to be double for a distance equivalent to twice the breadth of the girder. The rivets are to be spaced $4\frac{1}{2}$ diameters apart

(*c*) In middle line bulkheads, whether perforated or not, the seams of the plating may be single riveted.

(*d*) The rivets attaching the frames to the shell plating are to be spaced $5\frac{1}{2}$ diameters apart, centre to centre. The rivets attaching the stiffeners to the bulkhead plating are to be spaced 6 diameters apart, centre to centre.

(*e*) The attachments of the frame brackets to the margin plate in way of the oil fuel bunker are to comply with the requirements of Section 20, C 3.

7. **Workmanship.**—(*a*) The workmanship throughout is to be of the highest character, and is to be submitted to the closest inspection.

(*b*) Plates are to be sheared from the faying surface.

(*c*) Particular attention is to be given to the removal of burrs, drillings and rimerings.

(*d*) Where holes for rivets are punched, the diameter of the punch is not to be more than $\frac{1}{16}$ inch greater than the diameter of the rivet.

Holes in liners are to be the same size as those in the plates.

Where there is difficulty in securing fairness of the holes, drilling in position should be resorted to.

(*e*) Where any unfairness exists in rivet holes, they are to be rimered and re-countersunk. Larger rivets are to be used for rimered holes.

(*f*) Surfaces of steel plates are to be fitted close to each other, and are to be caulked as far as practicable without the use of packing. Where packing is unavoidable, the material to be used should be non-soluble in oil.

(*g*) Where boundary bars consist of double angles, both flanges of each bar are to be caulked.

(*h*) Angle or T-bar connections, which are situated on a caulking side, are to be caulked.

(*i*) Attachments of fittings are to be made, as far as possible, without through fastenings. Where through bolts are fitted, they should be tapped, grommetted and set up.

8. **Ventilators.**—'Tween deck ventilators to oil fuel tanks are to have scantlings suitable to withstand the pressure to which they may be subjected and are to be made watertight. Gauze diaphragms are to be fitted over the mouths of the ventilators.

9. **Drainage.**—(*a*) Efficient means are to be provided by wells or gutterways, and sparring or lining, to prevent leakage from any of the oil fuel compartments from coming into contact with cargo, and to ensure that any such leakage shall have free drainage into the limbers or wells. Where the boundary bulkheads of the oil compartments are welded, including their boundary connections, these requirements may be dispensed with except that a gutterway is to be provided in the boiler rooms.

For refrigerated vessels, *see* Section 3, clause 4 of the **Rules for Refrigerating Machinery and Appliances.**

(*b*) Where there is a possibility of oil leakage from bunkers, storage tanks, settling tanks, service tanks, pumps, heaters, and other apparatus, suitable gutterways, cofferdams, drip trays, or drip screens, are to be arranged, and provision is to be made for draining these.

(*c*) Where cargo or coal is carried in a compartment adjacent to an oil fuel settling tank, which may be heated, the compartment side of the tank is to be insulated to prevent heating of the cargo or coal.

(*d*) Compartments for storing fresh water either for use in boilers or for drinking should be separated from oil compartments by cofferdams.

10. **Testing.**—Tanks are to be tested by a head of water equal to 80 per cent of the depth of the tank, or 8 feet, whichever is the greater, provided the tanks are fitted with overflows or other means to prevent the occurrence of a greater pressure than the test head above. Where the tanks are not fitted with overflows or other similar devices, they are to be tested by a head sufficient to give the maximum pressure which can be experienced in practice, but in no case less than 8 feet. In all cases the pressure to which the tanks will be subjected is to be indicated on the plans submitted for approval.

The attachment of all fittings to oil-tight surfaces should be completed before the tanks are tested. In any case, all oil-tight surfaces are to be examined prior to the completion of the vessel.

11. **Bulkheads forming part of Watertight Subdivision.**—Where the boundary bulkheads form part of the watertight subdivision of the vessel, the scantlings and arrangements of these bulkheads are not to be less than required by Section 17.

C. DOUBLE BOTTOMS.

1. **General.**—(*a*) Oil fuel may be carried in ordinary cellular double bottoms.

(*b*) Holes are not to be cut in the centre girder, except in way of the narrow tanks at the ends of the vessel. The centre girder need not be caulked or tested.

(*c*) The lengths of the compartments are to be submitted for approval.

(*d*) Compartments for storing fresh water, either for use in boilers or for drinking, should be separated from oil fuel compartments by cofferdams.

2. **Riveting.**—(*a*) Where ceiling is fitted the scantlings and riveting may be as required for water ballast tanks. Where ceiling is not fitted the inner bottom plating is to have a minimum thickness of ·40 inch when the spacing of the frames is as required by the Rules and the seams and butts are to be at least double riveted.

(*b*) In the engine and boiler spaces the seams and butts of the inner bottom plating are to be at least double riveted.

(*c*) Ceiling, if fitted, is to be laid on transverse battens, leaving at least one half inch air space between the ceiling and the tank top.

3. **Gussets.**—(*a*) Where gussets are required by **Table 8** at every frame, a continuous plate is to be fitted attaching the tank side brackets to the inner bottom, and the number of rivets attaching this plate to the tank side brackets and to the inner bottom is to be 30 per cent in excess of the number required by **Table 8.**

Where gussets are required by the Table at alternate frames, a continuous plate is to be fitted as described above, and the number of rivets attaching this plate to the tank side brackets at each frame is to be 60 per cent of the number of rivets required by **Table 8** at alternate frames.

The rivets attaching the continuous plate to the inner bottom may be spaced 5 diameters apart, but the number in each frame space is not to be less than the number connecting the plate to the tank side bracket.

Where gussets are required by the Table at every third frame, gusset plates are to be fitted at every second frame and the number of rivets in each arm is to be as specified in **Table 8** for every third frame.

Where gussets are not required by the Table, the number of rivets in the vertical bar attaching the tank side brackets to the margin plate is to be increased 40 per cent.

For refrigerated vessels carrying oil fuel in double bottom, *see* **clause 4** of this section.

(*b*) The holes in the margin plates to take the gusset plate rivets are to be countersunk, and countersunk headed rivets are to be used.

(*c*) The above requirements are also to be complied with where oil fuel is carried in bunkers or deep tanks above an inner bottom compartment.

4. **Vessels carrying Refrigerated Cargoes.**—(*a*) The tank side brackets and the floor plates are to be attached to the margin plate by tee bars or by welding.

(*b*) Gussets are to be attached to the inner bottom plating by welding.

(*c*) The connections of hold pillars to the inner bottom, including the doubling plates, are to be welded.

(*d*) The attachments of manhole covers are not to penetrate the inner bottom plating.

5. **Testing.**—All double bottom compartments intended for carrying oil fuel are to be tested by a head of water representing the maximum pressure which could be experienced in service.

The attachment of all fittings to oil tight surfaces should be completed before the tanks are tested. In any case, all oil tight surfaces are to be xamin prior to the completion of the vessel.

6. **Workmanship.**—The workmanship is to be as required for Oil Fuel Bunkers.

D. FITTINGS AND CONTROL.

1. **General.**—In addition to the special requirements detailed below, the requirements of **Section 34** are to be complied with as far as they are applicable in respect to the drainage of tanks, oil bilges and cofferdams, and in respect to the height of air pipes above the freeboard or superstructure decks.

2. **Service, Settling and other Tanks.**—Where such tanks do not form part of the structure of the vessel, the scantlings and arrangements are to be submitted for approval.

In general, the thickness of the plating of these tanks is to be not less than $\frac{1}{4}$ inch, but in the case of very small tanks, the thickness of the plating may be not less than $\frac{1}{8}$ inch. Adequate stiffening of the plating is to be provided where necessary.

3. **Air, Overflow, and Sounding Pipes.**—(*a*) Each oil fuel compartment is to be fitted with one or more air pipes, the discharge ends of which are to be led to the open air in a situation where no danger will be incurred from the issuing oil vapour when the compartment is being filled, and each is to be furnished with a wire gauze diaphragm which can readily be removed for cleaning or renewal.

Where no overflow pipes are fitted, the sectional area of the air pipes to each compartment is to be not less than that of its filling pipe.

(*b*) Where overflow pipes are fitted to any oil fuel compartments, they are to have not less sectional area than the filling pipes, and are to be so arranged that no oil or vapour issuing from them will be a source of danger.

For this purpose overflow pipes from oil fuel tanks are to be led either overboard or to overflow tanks of adequate capacity.

Overflow pipes not exceeding 3 inches bore may discharge into suitably constructed oil wells of adequate capacity situated in the lower part of the machinery space, provided the outlet end is in a well lighted and readily visible position where no danger will be incurred from the issuing oil, and a liquid seal or trap be used to prevent the discharge of vapour into the machinery space.

If the overflow tanks or overflow wells are not of adequate capacity, an approved alarm device is to be fitted on the overflow pipes.

Where the overflow pipes are led to tanks which may be pumped up with water ballast, non-return valves are to be provided on the overflow lines to prevent water ballast entering the oil fuel tanks, or, alternatively, a suitable change-over device is to be provided.

(*c*) Each oil fuel compartment is to be provided with a suitable means for ascertaining the oil level therein, either by sounding pipes or by approved indicating apparatus. If sounding pipes are fitted, they are to be led to the weather deck, or to an accessible position on a deck above the load water line.

Where this arrangement is not practicable, short sounding pipes may be fitted in machinery spaces and tunnels, provided these pipes be led to readily accessible positions above the platforms and be fitted with lock-up screw caps of approved type or with cocks having parallel plugs with permanently secured handles so loaded that on being released they automatically close the cocks. Doubling plates, or their equivalent, are to be fitted under all sounding pipes for the rod to strike upon.

(*d*) Round gauge glasses are not to be fitted either to the oil storage, settling, or service tanks, but suitably protected gauges of approved design, having flat glasses of substantial thickness, and self-closing cocks or valves, may be allowed on settling and service tanks.

(*e*) Where sounding pipes or gauge glasses of approved type are not fitted, the level indicating apparatus is to be of approved type and is to be tested after fitting on board, to the satisfaction of the Surveyors.

(*f*) Sounding pipes to oil fuel compartments are not to terminate in refrigerated chambers or in fan and battery rooms for refrigerated chambers.

(*g*) Where practicable sounding pipes to oil fuel compartments are not to terminate in enclosed spaces from which access is provided to refrigerated chambers or to fan and battery rooms for refrigerated chambers.

Where these sounding pipes terminate in such spaces these pipes are to be fitted with cocks having parallel plugs with permanently secured handles so loaded that on being released they automatically close the cocks.

4. **Boiler Insulation.**—(*a*) The boilers are to be suitably lagged. The clearance spaces between the boilers and tops of the double bottom tanks, and between the boilers and the sides of the storage tanks or bunkers in which oil fuel is carried, are to be adequate for the free circulation of air necessary to keep the temperature of the stored oil well below the flash point.

(*b*) Where water tube boilers are installed, it is recommended that there should be a space of at least two feet six inches between the tank top and the underside of the pans forming the bottom of the combustion spaces.

(*c*) Funnel dampers, if fitted, must be provided with a suitable device whereby they may be securely locked in the fully open position. Funnel dampers must not be fitted on ships equipped for burning oil fuel only.

(*d*) Smoke box doors are to be shielded and well fitting, and the uptake joints made airtight.

5. **Oil Fuel Pumps and Oil Burning Appliances.**—(*a*) In every ship where steam for main or auxiliary machinery required for essential services at sea is to be produced by burning oil fuel, there are to be no fewer than two units (a unit comprising pressure pump, suction and discharge filters, and heater). The pressure pumps for the oil fuel burning system are to be entirely separate from the feed, bilge and ballast pumps and connections.

(*b*) All pumps used in connection with oil fuel are to be provided with effective escape valves, which are to be in close circuit, i.e., discharging to the suction side of the pumps.

(*c*) If the oil fuel is sprayed by steam, means are to be provided to carry or make up the fresh water used for this purpose.

(*d*) A starting-up oil fuel unit, including an auxiliary heater and hand pump, or other suitable starting-up device, is to be provided.

6. **Oil Pipes and Fittings.**—(*a*) The oil pressure pipes conveying heated oil are to be of solid drawn steel, and placed in sight above the platforms in well-lighted parts of the stokehold or engine-room. The coupling flanges are to be machined so that they are practically metal to metal, any jointing material used being the very thinnest possible, and impervious to oil heated to 250° F. The scantlings of the flanges are to be made

suitable for at least 200 lbs. per square inch working pressure, or the pressure to which the relief valves are loaded, whichever is the greater.

The pipes, heaters, and their fittings are to be tested after jointing to at least 400 lbs. per square inch, or to double the working pressure, whichever is the greater.

The working pressure of the oil fuel pressure pipes is to be determined from the formula contained in **Section 6, clause 13,** of the **Rules for Heavy Oil Engines.**

(*b*) Other oil fuel pipes, and all bilge or water pipes passing through oil storage tanks are to be made of iron or steel. The coupling flanges are to be machined and the jointing material used is to be impervious to oil. The scantlings of the flanges are to be made suitable for not less than 100 lbs. per square inch working pressure, and, after jointing, the oil fuel pipes within the engine and boiler spaces are to be tested to 30 lbs. per square inch or twice the working pressure, whichever is the greater. All such pipes within the engine and boiler spaces are to be led sufficiently high above the inner bottom to facilitate inspection and repairs.

7. **Valves and Cocks.**—(*a*) All oil fuel suction pipes are to be fitted with valves or cocks at the bulkheads where they enter the machinery space.

(*b*) In the case of all oil fuel storage, settling and daily service tanks, other than double bottom tanks, the suction valves or cocks are to be secured to the tanks, and so geared that they may be shut off from positions which will always be accessible in the event of fire taking place in the compartment in which they are situated. In the case of peak tanks, these valves or cocks are to be fitted on the tank side of the peak bulkheads.

(*c*) All valves or cocks in the machinery space connected with oil fuel installations are to be capable of being controlled from above the engine and boiler room platforms.

(*d*) Where the filling pipes to settling and service tanks are not connected to the tanks near the top, they are to be provided with valves or cocks, controlled as in the case of the suction valves or cocks on these tanks, or else with non-return valves, secured to the tanks.

(*e*) Valves or cocks are to be interposed between the pumps and the suction pipes in order that the latter may be shut off when the pumps are opened out for overhauling.

(*f*) Test cocks or open drains for removing the water from oil fuel tanks are not to be fitted unless the cock or drain valve be of self-closing type.

(*g*) All valves in connection with the oil fuel apparatus are to be so constructed as to prevent the possibility of any cover being slacked back or loosened when operating the valves.

8. **Control of Pumps.**—The motive power of the oil fuel transfer and unit pressure pumps, and the steam supply for the fire extinguishing apparatus, are to be capable of being controlled from a position which will always be accessible in the event of fire taking place in the compartment in which they are situated as well as from the compartment itself.

9. **Compartments for Storage of Fresh Water.**—The pipes in connection with compartments used for storing fresh water either for boilers or for drinking are to be separate and distinct from any pipes that may be used for oil or oily water and are not to be led through tanks which contain oil.

10. **Tanks for Carrying Oil or Water Ballast Alternatively.**—(*a*) Where it is intended to carry oil fuel and water ballast in the same compartments alternatively, the valves or cocks connecting the suction pipes of these compartments with the ballast donkey pump, and those connecting them with the oil fuel transfer pump, are to be so arranged that the oil may be pumped from any one compartment by the oil fuel pump at the same time as the ballast donkey pump is being used on any other compartment. Where settling or service tanks are fitted of large capacity so that they do not require frequent replenishment, the above requirement may be dispensed with.

(*b*) In the case of deep tanks which can be used for oil fuel, water ballast or cargo, provision is to be made for blank flanging the oil fuel and water ballast filling and suction pipes when the tanks are being used for cargo, and for blank flanging the bilge suction pipes when the tanks are being used for oil fuel or for water ballast.

11. **Steam Heating Coils.**—(*a*) Where steam is used for heating oil fuel, or lubricating oil, either in bunkers, tanks, or heaters, the exhaust drains are to discharge the water of condensation into an observation tank where it can be seen whether or not it is free from oil.

(*b*) The steam heating pipes in contact with the oil fuel are to be of wrought iron or steel, and are to be tested, after being fitted on board, to twice their working pressure.

(*c*) The working pressure of the steam heating pipes is to be determined from the formulæ contained in **Section 13, clause 16,** of the **Rules for Engines and Boilers.**

12. **Ventilation.**—The spaces in which the oil fuel burning appliances and the oil fuel settling and service tanks are fitted are to be well ventilated and easy of access.

13. **Fire Extinguishing Apparatus.**—(*a*) Water service pipes and hoses are to be fitted so that the floor plates and tank top in way of boilers, oil fuel apparatus or deep storage tanks in machinery spaces can at any time be flushed with sea water.

(*b*) Steam is to be led to pipes perforated for the emission of steam into the lower parts of the boiler room or other machinery compartments containing oil fuel apparatus or deep storage tanks.

(*c*) The steam supply to the fire extinguishing apparatus is to be controlled as required by **clause 8.**

(*d*) Where steam fire extinguishing apparatus is not fitted in the machinery spaces of steamers or motorships, equivalent apparatus is to be provided, details of which are to be submitted for approval.

14. **General.**—(*a*) No wood fittings or bearers are to be fitted in the boiler rooms, or in the compartments containing the settling tanks.

(*b*) Savealls are to be fitted at the furnace mouths to intercept oil escaping from the burners.

(*c*) Bilge suction pipes of lead are not permissible in engine or boiler spaces where settling tanks or oil fuel appliances are situated.

(*d*) A plan of the oil fuel pumping arrangements is to be submitted in triplicate for consideration.

OIL CARRIED AS CARGO IN DEEP TANKS AND PEAK TANKS.

Section 20A. Where it is desired that a special notation be made in the Register Book indicating that a deep tank or a peak tank is considered to be structurally suitable for the carriage of oil as cargo, the following requirements are to be complied with.

1. **Flash Point.**—The flash point of the oil is to be above 150° F.

2. **Scantlings and Riveting.**—(*a*) The arrangements, stiffening and the scantlings, of tanks carrying vegetable oil and completely filled may be as prescribed for tanks carrying water ballast. The scantlings and arrangements of tanks carrying oil fuel, and of vegetable oil tanks intended to be used in the partially filled condition will be specially considered.

(*b*) The riveting and the system of testing for deep tanks carrying oil fuel or vegetable oil are to be as prescribed for tanks carrying water ballast.

3. **General.**—The arrangements for ventilation and drainage, fittings and control are to be as required for oil fuel bunkers.

For refrigerated vessels, (*see* **Section 3, clause 4** of the **Rules for Refrigerating Machinery and Appliances.**

4. **Notation.**—The notation to be made in the Register Book will be: "Carrying oil, F.P. above 150° F. in deep and/or peak tanks" or "Carrying vegetable oil in deep and/or peak tanks" as the case may be. Where it is desired to have indicated that the tanks are suitable for the carriage of either of the above commodities the notation will be "Carrying oil, F.P. above 150° F. or vegetable oil in deep and/or peak tanks."

5. **Loading Test.**—Where a Loading Certificate is requested, before a cargo of oil is loaded the tank should be tested under water pressure and examined for cleanliness to ensure that it is in a proper condition to receive the oil cargo.

In special circumstances the Committee would be prepared, with the consent of all interested parties, to consider alternative arrangements in respect of the testing of these tanks.

NON-WATERTIGHT BULKHEADS.

Section 21. 1. **Middle Line Bulkheads.**—(*a*) The thickness of the plating is to be ·30 inch in the holds, and ·26 inch in the 'tween decks. The bulkhead is to be attached at the top and bottom by single angle bars ·10 inch thicker than the bulkhead plating.

(*b*) The vertical stiffeners are to be of the sizes given in **Table 35**, and may be fitted two frame spaces apart provided the frame spacing does not exceed 30 inches. Where the frame spacing is greater than 30 inches the stiffeners are to be fitted on every frame and the scantlings may be correspondingly reduced.

Where quarter pillars are fitted the stiffeners may be reduced in strength by 20 per cent.

(*c*) The stiffeners at the ends of the hatchways are to be bracketed at top and bottom, and where reinforced hatchway end beams are fitted, these stiffeners are to be doubled or equivalent arrangements provided. The remainder of the stiffeners are to be riveted to the beams and are to be attached at the bottom by double riveted lugs.

2. **Bunker Bulkheads.**—(*a*) The thickness of the plating and the scantlings of the bars at top and bottom of longitudinal vertical bunker bulkheads are to be as required for the middle line bulkheads except that the lowest strake, which is to extend at least 24 inches above the level of the stokehold floor, is to be ·36 inch in thickness.

(*b*) The vertical stiffeners of longitudinal bulkheads which act as supports to the deck are to be of the sizes given in **Table 35.**

(*c*) Where longitudinal bulkheads do not act as supports to the deck the stiffeners are to be of the sizes given in **Table 35.**

(*d*) The stiffeners are to be fitted two frame spaces apart provided the frame spacing does not exceed 30 inches.

Where the frame spacing is greater than 30 inches the stiffeners are to be fitted on every frame, and the scantlings may be correspondingly reduced.

(*e*) The plating of transverse bunker bulkheads is to be as required for longitudinal bulkheads, and the stiffeners, which are to be spaced 36 inches apart, are to be in accordance with the requirements of Table 35.

(*f*) Where sloping bunker casings are fitted, the scantlings of the stiffeners are to be suitably increased, and the stiffeners are to be additionally supported from the deck beams by angle stays, attached by brackets to the deck beams and the casing stiffeners.

DETACHED SUPERSTRUCTURES.

Section 22. 1. "Short" Deck Superstructures.—(*a*) The scantlings of poops, forecastles and "short" bridges (*i.e.*, bridges of which the length does not exceed 15 per cent of the length of the vessel) are to be in accordance with the requirements of Table 25.

(*b*) All vessels are to have forecastles except in cases in which the scantlings of the vessel do not exceed the requirements for complete superstructure vessels. Where the conditions of service may necessitate the omission of the forecastle, additional sheer is to be provided as may be required by the Committee.

(*c*) Where steel decks are fitted on poops, short bridges or forecastles, the thickness is not to be less than in the following Table, except that steel decks which are sheathed need not exceed the thickness given in Table 25 for stringers and tie-plates.

	Beams at every frame.	Beams at alternate frames.
	Inches.	Inches.
Sheathed ...	·26	·30
Unsheathed ...	·30	·34

The thickness of plating given for forecastles in Table 25 is applicable to unsheathed decks with beams fitted at every frame. Where the decks are sheathed a reduction of ·06 inch may be permitted in the thickness of the plating, provided a minimum of ·26 inch is maintained.

(*d*) The seams of the side and deck plating and the butts of the side plating, stringer plates, deck plating, and tieplates may be single riveted.

2. "Long" Bridges.—(*a*) Where the length of the bridge exceeds 15 per cent of the length of the vessel, the scantlings are to be as required by Tables 22 and 23.

(*b*) The riveting of the butts and seams of the deck plating and of the side plating is to be as required by Table 39. The riveting of the seams of bridge side plating need not exceed the riveting of the side shell plating but the seams are in every case to be double riveted for four frame spaces at the ends.

3. Framing.—Partial bulkheads are to be fitted in bridges below large deckhouses, which bulkheads are to be in continuation of watertight bulkheads fitted below. Partial bulkheads may also be required to be fitted at other places.

4. Strengthening at ends of Poops, Forecastles and Bridges.—(*a*) Bridges. At each end of a bridge the upper deck sheerstrake and the upper deck stringer plate are to be increased in thickness by 50 per cent in the case of long bridges and 30 per cent at short bridges. In way of a long bridge the sheerstrake, strake below and the upper deck plating, as fitted in the wells, are to be extended within the ends of the bridge for a distance equal to one-third the breadth of the vessel. The bridge side plating is to be extended beyond the ends of the bridge and is to be supported by plate webs spaced not more than five feet from the ends of the bridge. The bulwark rail is to be connected to the bridge end bulkheads by substantial bracket plates, and similar bracket plates are to be fitted on the inner side of the bulkhead.

(*b*) Poops and Forecastles. The additional strengthening prescribed above is to be fitted at the fore end of a poop or at the after end of a forecastle, wherever the length exceeds 25 per cent of the length of the vessel.

5. Poop and Bridge Front Bulkheads.—(*a*) Bulkheads at the fore end of bridges, and of unprotected poops the length of which is 40 per cent or more of the length of the vessel, and of all poops covering machinery openings, are to have a thickness of ·30 inch in vessels 200 feet in length and under, and ·44 inch in vessels 380 feet in length and above.

(*b*) The bulkheads are to be stiffened with bulb angles of the sizes given in the following Table :—

Length of Ship.	Size of Bulb Angle Stiffeners.	Number of Rivets in Lugs.	Length of Ship.	Size of Bulb Angle Stiffeners.	Number of Rivets in Lugs.
Feet.	Inches.		Feet.	Inches.	
under 160	$5\frac{1}{2} \times 3 \times ·30$	3	360	$8\frac{1}{2} \times 3 \times ·42$	5
160	$6 \times 3 \times ·32$	3	400	$9 \times 3 \times ·44$	5
200	$6\frac{1}{2} \times 3 \times ·34$	4	440	$9\frac{1}{2} \times 3\frac{1}{2} \times ·46$	5
240	$7 \times 3 \times ·36$	4	480	$10 \times 3\frac{1}{2} \times ·48$	5
280	$7\frac{1}{2} \times 3 \times ·38$	4	520	$10\frac{1}{2} \times 3\frac{1}{2} \times ·50$	6
320	$8 \times 3 \times ·40$	5	560	$11 \times 3\frac{1}{2} \times ·52$	6

The stiffeners are to be spaced 30 inches apart, and efficiently connected to the deck plating at top and bottom by lugs having the number of rivets in each flange specified in the Table.

(*c*) Bulkheads at the fore end of bridges not covering deck openings are to have plating of the thickness required by **paragraph** (*a*), but the stiffeners may be 10 per cent less in depth than given by **paragraph** (*b*).

(*d*) Bulkheads of poops which do not cover machinery openings and are partially protected or less in length than 40 per cent of the length of the vessel are to have a thickness of ·24 inch in vessels 160 feet in length and under, and ·38 inch in vessels 400 feet and above in length. The bulkheads are to be stiffened by plain angles of the size given in the following Table, spaced 30 inches apart, and connected to the deck plating at top and bottom by lugs having the number of rivets in each flange specified in the Table.

Length of Ship.	Size of Angle Stiffeners.	Number of Rivets in Lugs.	Length of Ship.	Size of Angle Stiffeners.	Number of Rivets in Lugs.
Feet.	Inches.		Feet.	Inches.	
under 150	3 × 2½ × ·30	2	350	5½ × 3 × ·42	3
150	3½ × 2½ × ·32	2	400	6 × 3 × ·44	3
200	4 × 3 × ·34	2	450	6½ × 3½ × ·46	3
250	4½ × 3 × ·36	2	500	7 × 3½ × ·48	4
300	5 × 3 × ·38	3	550	7 × 3½ × ·50	4

6. Bulkheads at After End of Bridges and Forecastles:—The plating of bulkheads at the after end of bridges and forecastles is to be ·20 inch in thickness in vessels 160 feet in length and under, and ·30 inch in vessels 400 feet and above in length. The bulkheads are to be stiffened by plain angles of the size given in the following Table, spaced 30 inches apart.

Length of Ship.	Size of Angle Stiffeners.
Feet.	Inches.
under 150	2½ × 2½ × ·26
150	3 × 2½ × ·28
250	3½ × 3 × ·30
350	4 × 3 × ·32

7. Deckhouses.—(*a*) All deckhouses on upper decks, or on decks of superstructures, are to be of sufficient strength and, where the length of the deckhouse exceeds 10 per cent of the length of the vessel, plans showing the scantlings and arrangements are to be submitted for approval.

(*b*) The sides and ends of large deckhouses are to be supported by partial bulkheads and web frames, together with intermediate vertical stiffeners. The spacing of the partial bulkheads, or webs, is not to exceed 30 feet, and, where possible, these are to be fitted above the structural bulkheads of the vessel.

Web frames should also be fitted, where possible, at the sides of large doors.

(*c*) Care is to be taken, as far as possible, to minimise the effects of all discontinuities in the structure of deckhouses. Continuous coamings are to be fitted below and above doors and other openings, and the corners of all openings cut in the sides of deckhouses should be well rounded.

(*d*) The tops of the deckhouses are to be efficiently supported by beams of suitable scantlings, and the beams should, as far as possible, be fitted in line with the side stiffeners and be connected to them by bracket knees. In all vessels exceeding 300 feet in length where the top of the house forms the weather deck above passenger accommodation the beams are to be completely plated over the accommodation.

(*e*) The deckhouse sides are to be additionally stiffened in way of boats and the decks strengthened in way of the davits.

RAISED QUARTER DECKS.

Section 23. 1. **Scantlings.**—(*a*) In vessels of the raised quarter deck type the scantling numerals and moulded depth are to be taken to the upper deck.

(*b*) The scantlings and arrangements of the side framing in way of the raised quarter deck are to be determined by the moulded depth of the vessel taken to the upper deck in association with the framing depth (d) taken in way of the raised quarter deck.

(*c*) The scantlings of the raised quarter deck stringer and plating, sheerstrake and strake below, are to be as required by the Tables for a vessel having a longitudinal numeral calculated as in **paragraph** (*a*) in association with a proportion of length to depth taken to the raised quarter deck, but no addition need be made to the thickness of the deck stringer and plating on account of proportion of length of vessel covered by superstructures.

2. **Break Bulkhead.**—The front or break bulkhead of the raised quarter deck is to have the thickness of the plating required for bridge front bulkheads, and is to be efficiently stiffened.

3. **Strengthening at Break.**—(*a*) The upper deck stringer plate is to extend abaft the break about four frame spaces, and the raised quarter deck stringer plate is to be extended about three frame spaces forward of the break; the bridge stringer is also to be extended abaft the break.

(*b*) In vessels which require a steel deck or part steel deck, the upper deck plating is to scarph the raised quarter deck for a length of two to three frame spaces according to the size and proportions of the vessel, and the upper deck stringer plate is to extend two or three frame spaces abaft the deck plating.

(*c*) Sufficient diaphragm plates are to be fitted, of the thickness of the break bulkhead plating, to connect the two decks. They are to be attached to the decks and bulkhead by double angles, and are to be stiffened by an angle on the after edge and vertical stiffeners where necessary.

(*d*) The upper deck sheerstrake is to be increased in thickness and is to be extended for a reasonable distance abaft the break. In the case of a raised quarter deck connected to a long bridge the raised quarter deck sheerstrake is to be increased in thickness, and the bulwark plates of the raised quarter deck adjoining the bridge side plating are also to be increased in thickness.

CRUISER STERNS.

Section 24. 1. **Length.**—Where vessels have cruiser sterns, the length (L) of the vessel is to be measured in the manner required by **Section 3, clause 1.**

2. **Framing.**—(*a*) The frames abaft the after perpendicular are to be spaced 24 inches apart, and are to be of the size required for bulb angle frames in peaks, and are to extend to the strength deck.

(*b*) Floor plates are to be of a reasonable depth, depending upon the form of the vessel, and are to be supported at the centre line by an intercostal girder.

(*c*) Additional stiffening in the form of web frames and longitudinal girders is to be provided as may be necessary.

3. **Beams.**—Beams are to have the scantlings required by the Rules for the respective decks.

4. **Plating.**—The plating round the cruiser stern is to be of the thickness required by **Tables 18** and **19** for side shell plating at ends. The riveting of the landing edges and butts is to be the same as that of the corresponding strakes of shell plating at ends, but the edges and butts are not to be less than double riveted up to the strength deck.

5. **Pillaring.**—Pillaring arrangements are to be fitted to the satisfaction of the Surveyors.

HATCHWAYS AND DECK OPENINGS.

Section 25. 1. **Height of Coamings.** — The minimum height of coamings above decks is to be as follows:—

On upper decks, except as qualified below, where exposed to weather ...		24 inches.
On upper decks of vessels whose draught does not exceed that which could be assigned as a Complete Superstructure vessel, on raised quarter decks and on decks of superstructures where exposed to the weather ...	When within $\frac{1}{4}$ of the vessel's length from the stem ...	24 ,,
	When aft of the above ...	18 ,,
On decks inside superstructures the openings in the latter having no means of closing		18 ,,
On decks inside superstructures the openings in the latter being closed by strong hinged wood doors or wooden shifting boards fitted in channels or equivalent		9 inches.

On decks below the upper deck, or within an intact superstructure, the coaming plates need not extend above the deck, but in such cases an angle coaming is to be fitted round these hatchways; all openings in decks are required to be framed.

2. **Thickness of Coamings.**—(*a*) In hatchways on the upper deck or on superstructure decks where exposed to the weather, the side and end coamings are to be not less than ·44 inch in thickness in vessels exceeding 200 feet in length. For vessels 100 feet long, the coamings are to be ·36 inch in thickness, and for vessels of intermediate length the thickness may be obtained by interpolation.

(*b*) In hatchways below the upper deck, or within an intact superstructure, the side and end coamings are not to be less than ·40 inch in thickness.

3. **Construction of Coamings.**—(*a*) Angles connecting coamings and deck plating are to be of the thickness of the coamings to which they are attached, and where a wood deck is fitted, the vertical flange is to extend half-an-inch above such deck.

The angles connecting the side and end coamings are to be of the thickness of the coamings.

(*b*) Hatchway coamings, which are required by clause 1 of this Section to extend above the deck, are to be caulked and made watertight, and the angles connecting these hatchway coamings to the deck plating are to be turned or welded at the corners.

(*c*) The side coamings of all hatchways are to extend to the lower edge of the beams.

(*d*) Hatchway side coamings, which are 24 inches or more in height above the deck, and which are above 10 feet in length, are to be stiffened by horizontal bulb angles, not less than 7 inches in depth, fitted near their upper edges.

Where hatchways exceed 10 feet in breadth, the end coamings are to be similarly strengthened, or be made equivalent thereto. A substantial moulding is to be fitted to the upper edges of the coaming plates.

Additional support is to be afforded by fitting brackets or stays from the bulb angle to the deck at intervals of not more than 10 feet. Where the coamings are 36 inches in height and above, plans showing the construction are to be submitted for approval.

(*e*) Where the pillars abreast the hatchways are spaced more than 4 frame spaces apart, or where the line of pillars at sides of hatchways is more than 18 inches from the coamings, the coamings will require to be made sufficiently strong as a girder to support the deck load, and plans of such cases are to be submitted for approval. (*See* Section 16.)

4. **Hatchway Beams.**—(*a*) At hatchways which are required by paragraph 1 to be 24 inches in height, the hatchway beams and fore and afters are to be of the sizes given in Table 36A in vessels 200 feet and more in length. In vessels not exceeding 100 feet in length the scantlings may be taken from Table 36B.

At weather deck hatchways which are required to be 18 inches in height, the beams and fore and afters may be of the sizes given in Table 36B.

At 'tween deck hatchways the scantlings are to be in accordance with Table 36A except in spaces fitted exclusively for the accommodation of passengers when they may be as given in Table 36B.

In no case are hatchway beams to be more than 10 feet apart.

(*b*) Where the height of 'tween decks exceeds 8 feet 6 inches the scantlings of the hatchway beams and covers are to be suitably increased.

(*c*) The web plate beams are to be stiffened at their upper and lower edges by double angles, of the size required by Tables A and B except where bulb plates are fitted, when the top angles only are required. The angles at the upper edges are to extend to the extreme ends in all cases, and are not to be recessed where fore and afters are fitted.

The ends of the web plates are to be flushed up on each side by doubling plates, having the same thickness as the angle mountings, and at least 7 inches wide.

Where no fore and afters are fitted, the alternate web plates are to extend to the top of the wood hatches.

(*d*) Steel fore and afters are to have angle mountings at the upper edges, as required by Table 36, and these mountings are to extend to the extreme ends in all cases.

Bearing pieces of heavy angle bar are to be fitted on the lower edge in way of each hatchway beam which they cross.

(*e*) Wood fore and afters are to be of pitch pine, or other wood of not less hardness and strength, and are to be free from defects. Steel shoes, at least $7 \times \cdot 5$ inches are to be fitted at each end of wood fore and afters, and plate bearing pieces, at least $9 \times \cdot 5$ inches, in way of each hatchway beam which they cross.

5. **Carriers.**—(*a*) All hatchway beams and fore and afters are to be efficiently supported at their ends by steel carriers, with a length of bearing of not less than 3 inches; they are to be fitted close to the sides and throat of the hatchway beams and fore and afters. Where carriers are of angle bars they are to be not less than ·50 inch in thickness, and one bar of each carrier is to extend at least to the level of the deck.

(*b*) Where the carriers adopted are of a form such as will not permit them to be extended to the deck, the thickness of the hatchway side coaming must be increased.

(*c*) Where fore and afters extend across hatchway beams, strong lugs are to be fitted on the beam to keep the fore and afters in position.

(*d*) The bottoms of all carriers are to be solid, or are to be efficiently secured by not less than two $\frac{7}{8}$ inch rivets.

6. **Hatch Covers.**—(*a*) Hatch covers are to be fitted to the hatchways in way of all laid decks. Solid covers are to have a finished thickness of $2\frac{3}{8}$ inches in association with an unsupported span of 5 feet. Where grating covers are fitted they are to be of sufficient strength. The ends of the wood covers are to be protected by encircling galvanised steel bands about $2\frac{1}{2}$ inches wide and $\frac{1}{8}$ inch thick, efficiently secured.

(*b*) Where it is desired to adopt a wider spacing of beams than given above, the thickness of the covers is to be increased and is to be not less than 3 inches where the unsupported span is 6 feet.

(*c*) Hatch covers may be dispensed with at decks below the upper deck or within an intact superstructure, as defined in the last paragraph of **clause 1**, if desired by the owners, and, in any case where they are so dispensed with, the Certificate of Classification will be suitably endorsed, and a corresponding notation made in the Register Book.

7. **Hatch Rests.**—Hatch rests are to be at least $2\frac{1}{2}$ inches wide and, where necessary, the hatch rests are to be bevelled so as to provide bearing surface not less than that width.

8. **Cleats, Battens, and Tarpaulins.**—Cleats, not more than 2 feet apart centre to centre, are to be fitted to the coamings of all hatchways on or above the upper decks, unless such hatchways are within an intact superstructure; the end cleats are to be placed not more than 6 inches from the hatchway corners.

Cleats are to be of an approved pattern, at least $2\frac{1}{2}$ inches wide, with edges so rounded as to minimise the cutting of the wedges. The thickness should not be less than $\frac{3}{8}$ inch for angle cleats and $\frac{7}{16}$ inch for smithed cleats which should be stiffened by pressing out the centre to form a web extending to the bottom of the palm. Drop forgings should be of equivalent strength. Cleats should be set so as to fit the taper of the wedges.

Tarpaulins in good condition are to be provided for all hatchways on superstructure decks, in exposed positions on freeboard decks, and within superstructures which are not permanently enclosed. Not less than two tarpaulins are to be provided to all hatchways in exposed positions.

Tarpaulins are to be free from jute, thoroughly waterproofed and of ample strength. The minimum weight of the material, before treatment, shall be 19 ounces per square yard if to be tarred, 18 ounces per square yard if to be chemically treated, or 16 ounces per square yard if to be dressed with black oil. A certificate to the above effect shall be supplied by the makers of the tarpaulins.

Battens and wedges are to be efficient and in good condition. Wedges are to be of tough wood, generally not less than 8 inches in length and 2 inches in width. They should be cut to a standard taper of 1 in 6 and should not be less than $\frac{1}{2}$ inch in thickness at the point.

Where the coamings are required to be 24 inches in height, steel bars or other equivalent means are to be provided for efficiently and independently securing each section of hatchway covers after the tarpaulins are battened down.

Where the hatchway covers extend over intermediate supports, steel bars or their equivalent are to be fitted at each end of each section of the covers.

At all other hatchways in exposed positions on weather decks, ring bolts or other fittings for lashings are to be provided.

9. **Bunker Hatchways.**—The minimum heights of coamings of these hatchways are to be in accordance with clause 1, and covers, beams, and battening down arrangements as effective as those required for cargo hatchways are to be fitted. If the deck beams in way of these openings are cut, fore and aft coaming plates are to be fitted to take the beam ends.

10. **Flush Bunker Scuttles.**—Flush bunker scuttles may be fitted in the following positions:—

(*a*) On bridge decks, poop decks, raised quarter decks, or on upper decks of complete superstructure vessels having tonnage openings.

(*b*) In positions which are always accessible on decks inside superstructures where the openings in the latter are closed with efficient closing appliances.

The scuttles are to be of iron or steel, of substantial construction, and are to have screw or bayonet joints. Where the scuttles are not secured to the frames by hinges, a permanent chain attachment is to be provided.

11. **Escape Scuttles.**—(*a*) Where escape scuttles are fitted on the weather decks, strong coamings having a minimum height above the deck, as required by **clause 1**, are to be fitted, and are otherwise to comply generally with the requirements of this Section.

(*b*) Where escape scuttles are fitted on decks inside superstructures, the openings in the latter being closed by strong hinged wood doors or wood shifting boards fitted in channels or equivalent, the scuttles are to be provided with either

1. Strong coamings 9 inches in height with weathertight wood covers,

or

2. Angle coamings with hinged watertight steel covers secured by strong backs or closely spaced bolts and nuts.

(*c*) Where escape scuttles are fitted in the 'tween decks and on decks within intact superstructures, the openings are to be provided with angle coamings and wood covers are to be fitted. This requirement may be modified to suit special conditions of trade on application being made to the Committee by the Owners.

12. **Trunked Hatchways.**—Where hatchways are trunked through one or more 'tween decks, and the hatchway beams and covers are dispensed with at the intermediate decks the hatchway beams, fore and afters, coamings and deck immediately below the trunk are to be adequately strengthened, and in such cases plans are to be submitted for approval.

Where the trunkways are intended to take the place of 'tween deck pillars in way of the hatches, they are to be of steel and are to be efficiently stiffened.

13. **Companions.**—Companions on exposed decks should be of steel and be securely riveted to the deck.

14. **Mast Holes.**—In way of mast wedging, where iron or steel decks are not fitted, plates are to be riveted to the beams, of not less thickness than is required for stringer plate amidships, and of not less width than three times the diameter of the mast.

VENTILATORS.

Section 26. 1. **Number and Size.**—Ventilators, sufficient in number and size, are to be efficiently fitted to weather decks of all vessels.

2. **Ventilator Coamings.**—(*a*) Where exposed to the weather the minimum height of coamings of ventilators to cargo spaces is to be 36 inches on upper decks except as qualified below. On upper decks of vessels whose draught does not exceed that which could be assigned as a Complete Superstructure vessel, on raised quarter decks and on decks of other superstructures, the minimum height of coaming is to be 30 inches except on superstructure decks within one-fourth of the vessel's length from the stem where the height is to be 36 inches.

If ventilator coamings are fitted of a greater height than 36 inches and are not efficiently supported by adjacent structures, they are to be strongly stayed or bracketed to the deck.

(*b*) The scantlings of the coamings and their attachment to the deck are to be in accordance with the following Table :—

VENTILATOR COAMINGS.

Internal Diameter of Ventilator Coaming.	Coaming Plate.	Deck Bar.
Inches.	Inch.	Inches.
6 and not exceeding 8	·30	3 × 3 × ·34
Above 8 „ „ 11	·32	3 × 3 × ·36
„ 11 „ „ 13	·34	$3\frac{1}{2} \times 3\frac{1}{2} \times ·38$
„ 13 „ „ 15	·36	$3\frac{1}{2} \times 3\frac{1}{2} \times ·40$
„ 15 „ „ 17	·38	$3\frac{1}{2} \times 3\frac{1}{2} \times ·42$
„ 17	·40	$3\frac{1}{2} \times 3\frac{1}{2} \times ·44$

The rivets in these bars are to be $\frac{3}{4}$ inch diameter for ventilators not exceeding 15 inches in diameter, and $\frac{7}{8}$ inch for ventilators greater than this diameter, and are to be spaced 4 diameters apart, centre to centre.

(*c*) A steel ring may be riveted to the outside of the coaming to provide a proper bearing for the cowl, and the housing is to be not less than 15 inches.

(*d*) In cases where a steel deck is sheathed with wood the coaming is to be riveted direct to the steel deck, and the vertical flange of the bar is to extend at least half-an-inch above the wood sheathing.

3. **Stiffening of Deck below Ventilators.**—The deck plating in way of the ventilators is to be efficiently stiffened between the beams.

4. **Covers.**—All ventilator coamings are to be provided with strong plugs and canvas covers or equally efficient appliances for closing the openings when the cowls are unshipped.

5. **Mushroom and Gooseneck.**—Such ventilators when fitted to accommodation spaces are to be substantially constructed and efficiently bolted to the deck plating.

6. **Scuttles in Topsides.**—Side scuttles to spaces below the freeboard deck or to spaces within enclosed superstructures are to be fitted with efficient inside deadlights, permanently attached and capable of being closed watertight.

In enclosed superstructures permanently allocated to passengers or to crew, portable deadlights may be provided if stowed beside the scuttles.

7. **Mechanical Ventilation.** — Where a system of mechanical ventilation is adopted, sketches showing the construction of the tanks, fan casings and so forth, on the weather deck are to be submitted for approval.

8. **Alternative arrangements.**—Should the owners desire it, other arrangements proportionate to those prescribed in this Section may be adopted.

ENGINE AND BOILER SPACE.

Section 27. 1. **Engine and Boiler Bearers.**—(*a*) Engine and boiler bearers are to be of substantial construction and are to be efficiently supported by brackets, both longitudinally and transversely.

(*b*) Where engines are bolted direct to the inner bottom, the thickness of the plating under the engines is to be suitably increased.

(*c*) In single bottom vessels the floors in the engine space are to be increased in depth.

(*d*) In all vessels additional fore and aft girders are to be fitted in way of the engine seating and thrust block seating and are to be attached to the shell.

(*e*) Where it is intended to fit engines of special type or of greater power than in ordinary cargo carrying steamers, the engine seating is to be proportionately increased, and plans are to be submitted for approval.

2. **Additional Strengthening in Machinery Space.**—Additional transverse strengthening by means of web frames and strong beams, or otherwise, is to be provided in the machinery space.

3. **Clearance between Bulkheads and Boilers.**—Coal bunker and hold bulkheads are to be kept well clear of boilers and uptakes.

Where the boiler room bulkhead is recessed for a boiler, the recess is to be of a size sufficient to provide space all round the boiler for proper access.

The roof of the recess is not to be less than 4 feet clear of the top of the boiler, the space between the bunker plating and the uptake is not to be less than 18 inches, and a baffle plate is to be fixed between the uptake and the bulkhead, or other efficient means are to be provided.

Uptakes and flat surfaces of boilers are not to be less than 18 inches, and cylindrical shells of boilers are not to be less than 9 inches, from coal bunker and hold bulkheads.

4. **Protection of Deck under Donkey Boilers.**—Where donkey boilers are placed on the decks of vessels the deck underneath is to be increased ·10 inch in thickness, and is to be protected by being covered with firebrick or cement not less than 2 inches in thickness. A similar increase in thickness and means of protection are to be fitted to decks on which fires may be drawn from any donkey boiler.

ENGINE AND BOILER OPENINGS.

Section 28. 1. **Extent and Construction of Machinery Casings.**—(*a*) Engine and boiler openings on the weather deck are to be protected by properly framed casings of substantial construction.

(*b*) The minimum height of casings on upper decks, except as qualified below, is to be 6 feet in vessels not exceeding 270 feet in length, and 7 feet 6 inches in vessels 400 feet in length and above.

(*c*) On upper decks of vessels whose draught does not exceed that which could be assigned as a Complete Superstructure vessel, and on decks of superstructures where exposed to the weather, the height of the casing is not to be less than 2 feet 6 inches.

(*d*) The engine and boiler openings should be made as small as practicable, and as many cross ties as possible are to be fitted at each deck. The tops of the side casings are to be efficiently connected by beams and plating.

(*e*) In the cases of vessels referred to in paragraph (*b*) above, the thickness of the casings is not to be less than ·26 inch for vessels 100 feet in length; ·30 inch in vessels 200 feet in length; and ·34 inch in vessels 300 feet and above in length; for vessels included in paragraph (*c*) above, the thickness of the casings is to be ·26 inch in vessels up to 200 feet in length, and ·30 inch in vessels 300 feet and above in length; the coaming plates are to be ·04 inch thicker than the plating.

(*f*) For casings 7 feet 6 inches in height, the stiffeners are to be spaced 30 inches apart, and for the vessels referred to in paragraph (*b*) are to be $3 \times 2\frac{1}{2} \times ·26$ inches angle in vessels 100 feet in length; $4 \times 3 \times ·28$ inches angle in vessels 200 feet in length; and $4\frac{1}{2} \times 3 \times ·30$ inches angle in vessels 300 feet and above in length; for all vessels included in paragraph (*c*) the stiffeners are to be $3 \times 3 \times ·30$ inches angle.

(*g*) The doors in casings on upper decks, except where the draught of the vessel does not exceed that which could be assigned as a Complete Superstructure Vessel, and on raised quarter decks are to be of steel, substantially constructed, permanently attached and capable of being closed and secured from both sides.

2. **Trunk Casings.**—Where the engine and boiler openings in the 'tween decks are enclosed by trunk casings they are to have ·26 inch plating and ·30 inch coamings and are to be suitably stiffened. Where the casings form the boundary of coal bunkers, the requirements of Section 21 are to be complied with.

3. **Skylights and Gratings.**—Engine room skylights are to be substantially constructed, and are to be securely bolted or riveted to the coamings.

Grating openings over stokehold are to be protected by hinged plate covers.

FREEING PORTS, SCUPPERS AND SANITARY DISCHARGES.

Section 29. 1. **Freeing Ports.**—(*a*) Where weather decks are enclosed by bulwarks, ample provision is to be made for rapidly freeing the decks from large quantities of water.

(*b*) The area of the openings provided for this purpose in the bulwarks at the upper decks of full scantling vessels and at raised quarter decks, irrespective of the height of the bulwarks, is to be in accordance with the following Table:—

Length of Well.	Area on each Side.	Length of Well.	Area on each Side.
Feet.	Square Feet.	Feet.	Square Feet.
15	8	55	12
25	9	65	13
35	10	75	15
45	11	85	17

On other superstructures of standard height the area should be one-half of that required in the Table.

(*c*) The lower edges of the freeing ports are to be as near the deck as practicable and all such openings are to be protected by rails or bars spaced not more than 9 inches apart. If hinged doors are also fitted over the openings their hinges are to have brass pins and there are not to be any fittings for keeping the doors closed.

2. **Scuppers.**—(*a*) Scuppers sufficient in number and size to provide thoroughly effective drainage are to be fitted in all decks.

(*b*) Where the weather deck stringer angle is cut in way of scuppers, a compensating bar is to be fitted below the stringer plate.

(*c*) Scupper pipes from spaces below the freeboard deck are to be led to the bilges, or may be led overboard provided they are from spaces above the load waterline and are fitted with a screw down automatic non-return valve capable of being operated from above the freeboard deck from a position which is always accessible. Means should be provided for showing whether the valve is open or closed.

(*d*) Scuppers from permanently enclosed superstructures may be led to the bilges. If desired, they may be led overboard, but if this is done it will be necessary, in certain cases, to provide arrangements similar to those indicated in the preceding paragraph.

(*e*) Scuppers from short superstructures with temporary closing appliances on an end bulkhead are to be fitted to drain overboard, with the exception of the scuppers within the range of the machinery space which may be led and drained to the bilges where the pipes are to be visible and readily accessible.

(*f*) Scuppers which drain overboard from spaces referred to in paragraphs (*d*) and (*e*) above and which are not required to have storm valves with positive means of control are to be fitted with storm valves of normal type.

(*g*) Scuppers in ships having complete superstructures, with a tonnage opening in the superstructure deck are, within the range of the machinery space, to be led to the bilges, where they are to be visible and readily accessible. Where, to ensure effective drainage of the spaces clear of the machinery, additional scuppers are required by the Committee, these scuppers are to be led to the hold bilges and fitted with screw-down valves at the second deck, the valves being controlled from an accessible position above the superstructure deck. Means should be provided for showing whether the valve is open or closed. Similar arrangements are to apply in ships having an erection covering the greater part of the length of the vessel and having temporary closing appliances in an end bulkhead.

(*h*) Plans showing the arrangement of scuppers for draining refrigerated cargo compartments are to be submitted for consideration.

3. **Sanitary Discharges.**—Sanitary discharges from spaces below the freeboard deck are to be provided with efficient and accessible means for preventing water from passing inboard. Each discharge is to be provided with a screw-down automatic non-return valve capable of being operated from an accessible position above the freeboard deck. Means should be provided for showing whether the valve is open or closed.

Alternatively two automatic non-return valves, without positive means of closing, may be fitted provided the upper valve is in a position which is always accessible for examination under service conditions.

Similar arrangements may be required at sanitary discharges from spaces within enclosed superstructures.

4. **Materials.**—Non-return valves are to be fitted in substantial castings of metal other than cast iron. The lower length of pipe is to be of iron or steel, galvanised and of substantial thickness, not less than standard steam pipe quality. Scupper pipes and discharges led through the ship's sides below the freeboard deck or through the sides of enclosed superstructures are to be of metal other than cast iron.

5. **Protection of Pipes in Holds and Bunkers.**—Where situated in cargo or coal bunker spaces, scupper pipes, discharges and screw-down valves and their controls are to be protected by a substantial casing which is to be of steel in coal bunkers.

RIVETING.

Section 30. 1. **Arrangement of Rivets.**—(*a*) The size and spacing of the rivets in the various parts of the structure are to be in accordance with the requirements of **Tables 38 to 40.**

The diameter of the rivet is to be regulated in general by the greater thickness of the parts to be connected, but where the difference is considerable, special consideration will be given.

(*b*) Chain riveting is to be adopted for the butts of shell plating and for double and treble riveted joints, except for the connections to bar keel, stem, and sternpost.

2. **Form of Rivet.**—Rivets are to be increased in size under their heads in order to fill the rivet holes properly. Pan-headed rivets are to be of the form shown in **Table 40,** except where the holes have been drilled.

3. **Countersinking.**—(*a*) The rivet holes in the plating of the shell, weather decks, inner bottom and bulkheads of peak tanks and deep tanks, are to be countersunk.

(*b*) The countersinking of the rivet holes is to extend through the whole thickness of the plate or angle where the thickness does not exceed ·50 inch. Above this thickness the countersinking is to extend through nine-tenths the thickness of the plate.

(*c*) The angles of countersink for plates whose thickness does not exceed ·50 inch is to be about 60 degrees and for plates exceeding this thickness the angle is to be about 45 degrees.

4. **Spacing of Rows of Rivets.**—(*a*) The breadths of butt straps, end laps, and edge laps, are to be in accordance with the requirements of **Table 38.**

(*b*) Rivets are to be kept sufficiently clear of edges of material and of each other, and the distance from the centre of rivet hole to the edges of plating, butt straps, end laps, or angle bars, is not to be less than one-and-a-half rivet diameters.

The distance between the centres of consecutive rows of rivets is to be two-and-a-half rivet diameters for edge laps; three rivet diameters for butt straps; three-and-a-half diameters in end laps.

5. **Rivets in Seams of Shell Plating.**—(*a*) The riveting of the seams of shell plating is to be as required by **Table 40.**

(*b*) In vessels 275 feet and above in length the seams of the side shell plating are not to be less than double riveted.

(*c*) In vessels above 500 feet in length an additional pair of rivets is to be fitted in each frame space in three seams at about one-half the depth of the vessel for one-fourth of the vessel's length in the fore and after bodies. The actual position of this additional riveting is to depend on the arrangement of the shell plating and the special design of the vessel in each case. In vessels above 525 feet in length one of the above seams, and in vessels above 550 feet in length two of the above seams, are to be treble riveted, the remaining seams or seam to be additionally riveted. Where the length of the vessel exceeds 600 feet the three seams are to be treble riveted.

Each case requiring this additional riveting is to be submitted for the approval of the Committee.

(*d*) In single riveted seams one frame rivet is to be fitted through the seams at each frame.

In double riveted seams one frame rivet is to be fitted through the seams at each frame, except where the frames or edges of the plating are joggled when two rivets are to be fitted.

In treble riveted seams two frame rivets (the upper and lower) are to be fitted through the seams at each frame.

6. **Spacing of Rivets.**—(*a*) All butt straps and end laps are to have complete rows of rivets.

(*b*) The rivets attaching the shell plating to the bottom frames are to be spaced as follows:—

Where the frame spacing does not exceed 31½ inches the rivet spacing is to be not more than 7 diameters.

Where the frame spacing exceeds 31½ inches but does not exceed 34½ inches, the rivet spacing is to be not more than 6½ diameters.

Where the frame spacing exceeds 34½ inches, the rivet spacing is to be not more than 6 diameters.

(*c*) The rivets attaching the shell plating to the side frames are to be spaced as follows:—

Where the frame spacing does not exceed 28½ inches, the rivet spacing is to be not more than 7 diameters.

Where the frame spacing exceeds 28½ inches, but does not exceed 31½ inches, the rivet spacing is to be not more than 6½ diameters.

Where the frame spacing exceeds 31½ inches, but does not exceed 34½ inches, the rivet spacing is to be not more than 6 diameters.

Where the frame spacing exceeds 34½ inches, the rivet spacing is to be not more than 5½ diameters.

(*d*) Where the framing consists of an ordinary frame and reverse bar as provided for in Tables 2, 3 and 4, the rivets attaching the reversed bars to the frames are to have the same spacing as the rivets through the frames and shell plating.

(*e*) In deep tanks and in fore and after peak tanks, the rivets through the frames and shell plating are to be spaced not more than $5\frac{1}{2}$ diameters apart from centre to centre.

(*f*) Forward of the half length the rivets in both flanges of the frame angles connecting the floors to the shell plating are to be spaced not more than $5\frac{1}{2}$ diameters apart from centre to centre.

(*g*) At the stem, sternframe, and bar keel, rivets are to be $\frac{1}{4}$ of an inch larger in diameter than required for the thickness of the plating, but need not in any case exceed $1\frac{1}{8}$ inches in diameter, and are to be spaced 5 diameters apart from centre to centre. In single screw steamers above 350 feet in length, the after lengths of the shell plating are to be connected to the portion of the stern frame below the boss with three rows of rivets.

(*h*) In the after peak, the rivets connecting the frames to the floors and cross ties are to be spaced not more than five diameters apart from centre to centre.

7. **Butt Straps.**—Where single butt straps are fitted, the straps are to be 25 per cent thicker than the plates to be connected. Where double straps are fitted, the thickness of the countersunk strap is to be 70 per cent, and the thickness of the strap on the opposite side 60 per cent of the thickness of the connected plates.

8. **Connection of Longitudinal Angles between Frames.**—The number of rivets between frames in each flange of the angle bars connecting stringer plates and intercostal plates to the shell plating is to be in accordance with the following Table :—

Frame Spacing.	Number of Rivets.
Not exceeding 26 inches	4
„ „ 30 „	5
„ „ 33 „	6
„ „ 36 „	7

9. **Breadths of Flanges of Bars.**—The breadths of the flanges of connecting angles are to be not less than four times the diameter of the rivet, for rivets up to $\frac{7}{8}$ inch in diameter, and three and one-half times for rivets one inch and over in diameter.

10. **General.**—The riveting requirements in various parts of the structure are to comply with the regulations indicated by the following references :—

(*a*) **Framing.**—Section 6, clause 7.

(*b*) **Straps of Web Frame and Side Stringer Face Bars.**—Section 7, clause 2.

(*c*) **Tank Side Brackets.**—Section 10, clause 8.

(*d*) **Bottom Forward.**—Section 11, clause 4.

(*e*) **Wider Frame Spacing.**—Section 14, clause 9.

(*f*) **Beam Knees.**—Section 15, clause 3.

(*g*) **Half Beams to Coaming Plates.**—Section 15, clause 3.

(*h*) **Pillars and Girders.**—Section 16, clause 6.

(*i*) **Bulkheads.**—Section 17, clause 7.

(*j*) **Shaft Tunnels.**—Section 18, clause 5.

(*k*) **Deep Tanks.**—Section 19, clause 10.

(*l*) **Oil Fuel Bunkers.**—Section 20, Sub-Section B clauses 6 and 7.

(*m*) **Oil Fuel Compartments.**—Section 20, Sub-Section C, clauses 2 and 3; Section 20A, clause 2(*b*).

(*n*) **Detached Superstructures.**—Section 22, clause 1.

(*o*) **Ventilators.**—Section 26, clause 2.

CEILING AND CARGO BATTENS.

Section 31. 1. **Ceiling.**—(*a*) In single bottom vessels close ceiling is to be fitted from the centre keelson to the upper part of the bilges. The ceiling is to be made in hatches as far as practicable, but when not so arranged is to be fastened to the reversed frames in such a manner as to permit easy access for the purpose of survey, or for cleaning and painting.

(*b*) In vessels having double bottoms, ceiling is to be laid over the limbers at the bilges and under the hatchways. The ceiling at the limbers is to be readily removable for inspection of the bilges. Ceiling may be omitted under the hatchway provided the inner bottom plating is increased ·08 inch in thickness in way of the hatchways.

(*c*) Where the cargo is intended to be discharged by grabs or similar mechanical appliances, it is recommended that the ceiling be doubled or the inner bottom plating be increased ·20 inch in thickness.

(*d*) Where the covers or fittings of the manholes of the inner bottom in cargo holds project above the tank top, they are to be protected by an angle coaming around each manhole, fitted with a hatch either of wood or steel.

(*e*) If the ceiling be laid on the top of the plating, it is to be embedded in a substantial composition such as Stockholm tar and cement. If the ceiling be not so embedded, it is to be laid on battens at least one-half inch thick to permit the drainage water to pass to the bilges.

(*f*) The thickness of the wood ceiling is to be not less than $2\frac{1}{2}$ inches in vessels exceeding 200 feet in length and 2 inches in all smaller vessels.

(*g*) The requirements regarding ceiling over double bottom compartments in which oil fuel is carried are set forth in **Section 20, Sub-Section C,** clause 2.

2. **Cargo Battens in Cargo Spaces.**—(*a*) Cargo battens are to be fitted above the upper part of the bilge and in the 'tween decks of all types of vessels and in permanently enclosed spaces in bridges, poops, and other deck superstructures.

(*b*) Cargo battens should be 2 inches in thickness, and the clear spacing between adjacent rows is not to exceed 9 inches.

(*c*) The cargo battens specified in the preceding paragraphs may be dispensed with at the request of the Owner. In such cases the certificate of classification will be endorsed "Cargo battens not fitted," and this notation will also be printed in the Register Book.

CEMENTING AND PAINTING.

Section 32. 1. **Cementing.**—(*a*) In single bottom vessels the frames and plating of the bottom to the upper parts of the bilges are to be efficiently covered with Portland or other approved cement, which may be mixed with sand or other material to form a suitable composition. Care is to be taken to have a proper thickness of cement at the edges, and to keep the watercourses clear all fore and aft.

(*b*) In double bottoms the frames and shell plating are to be efficiently cemented in the tanks under the boiler room, except where these tanks are intended solely for the carriage of oil fuel. Elsewhere inside the double bottom cement may be dispensed with.

In all cases the plating at the bilges is to be efficiently cemented or coated with a suitable composition. If cement is used, it should not extend above the upper edges of the tank margin angle.

(*c*) Where asphalt, enamel cement, or similar compositions are to be used, the same is to be sanctioned by the Owners, and samples are to be submitted for the approval of the Committee.

(*d*) Before any covering is applied, care is to be taken to ensure that the plating is thoroughly clean, and, in addition, where asphalt, enamel cement, or similar compositions are used, that the surface is dry.

2. **Painting.**—(*a*) All steel and iron work, not covered with cement, should receive at least two coats of paint of suitable composition. Previous to the painting, the surface of the steel and iron is to be thoroughly cleaned, and the painting of external steelwork should be delayed as long as possible.

(*b*) If desired by the Owners, cement washing may be adopted inside of double bottom tanks instead of painting.

STEERING GEAR.

Section 33. 1. **Steering Gear.**—(*a*) All vessels are to be fitted with two independent steering gears.

(*b*) In vessels exceeding 250 feet in length, one of the steering gears is to be operated by power.

(*c*) Hand gear of the right and left-handed screw and nut type is not to be fitted in vessels exceeding 300 feet in length.

(*d*) In all vessels an arrangement of blocks and tackle or other suitable alternative may be accepted as one of the two means for steering, provided it is fitted to the satisfaction of the Surveyor.

2. **Plans.**—In the case of rod and chain gear, complete plans of the main and auxiliary gears are to be submitted for approval showing clearly particulars and scantlings of the chains and rods, brake, sheaves, spring buffers, Warwick screws, shackles and other attachments, also the blocks, leads and tackle for the auxiliary gear.

3. **Scantlings.**—(*a*) The scantlings of tillers and quadrants are to be as given in **Table 45.** Quadrants and tillers are to be well shrunk on or bolted to the rudder head in addition to being secured by a key of suitable size. The area of the arms at ends may be one-third of the area given in the Tables, and where a quadrant tiller is not keyed to the rudder head, the area of the arms of the quadrant may be of these reduced dimensions throughout their length. Where cast steel tillers are fitted the scantlings are to be equivalent to those given in the Table.

(*b*) The diameters of the steering chains and rods, and the corresponding radii of quadrant tillers are given in **Table 45.** Where the radius of quadrant or length of tiller differs from that given in the Table, the diameter of the steering chain is to be suitably modified.

(*c*) All steering chains are to be subjected to the breaking and proof tests as set forth for short link cables in **Section 14** of the **Rules for the Quality and Testing of Materials.** These tests are to be carried out at a proving establishment recognised by the Committee, and the certificates are to be produced.

4. **Power of Engine.**—The power of the steering engine is to be such that the rudder can be put from hardover to hardover in 30 seconds while the vessel is going ahead at full sea speed.

5. **Spare Gear.**—A set of spares is to be provided consisting of one complete spring buffer and one extra spring, two tested chains each equal to the longest length in the gear, two Warwick screws, four shackles, four connecting links, and four rod pins.

In ocean-going vessels the speed of which is 12 knots and above, one buffer spring, one Warwick screw, and one length of chain may be dispensed with.

In ships engaged on short sea routes which have either a main gear which is, in practice, hand operated at sea, or an auxiliary gear, independent of the rods and chains, which can be effectively hand operated at sea, the spare gear may be confined to sufficient shackles or split links as may be required to enable repair of the gear to be readily effected in the event of its breakdown at sea. In all other cases of vessels engaged on short sea routes, the spare gear is to be as required for vessels the speed of which is 12 knots and above.

6. **Rudder Stops.**—Suitable stops for the rudder should be securely fastened to the deck in way of the tiller or quadrant tiller. The stops of the steering engine are to be fitted at a smaller angle of helm than the rudder stops.

7. **Locking or Brake Gear.**—An efficient locking or brake arrangement is to be fitted to keep the rudder steady when a change of gear is required.

8. **Protection of Steering Gear.**—In steamers above 250 feet in length, not having full poops, the after steering wheel and gear are to be protected by a substantially constructed steel house.

9. **Springs.**—Springs or buffers are to be fitted to all power operated steering gears.

10. **Leads of Steering Chains.**—(*a*) The leads of the steering chains are to be as direct as possible and sharp bends are to be avoided.

(*b*) The diameters of leading block sheaves, measured at the centre of the chain, are not to be less than sixteen times the diameter of the steering chains, and the pins of the sheaves are not to be less than twice the diameter of the chains.

PUMPING ARRANGEMENTS.

Section 34. 1. **General.**—In steam vessels the pumping arrangements according to the division of holds, rise of floor and other conditions are to be as follows, and plans of these arrangements are to be submitted for approval.

2. **Hold and Tank Drainage.**—(*a*) All steam vessels are to be provided with efficient pumping plant, having the suctions and means for drainage so arranged that any water which may enter any compartment of the ship, or any watertight section of any compartment, can be pumped out through at least one suction when the vessel is on an even keel, and is either upright or has a list of not more than five degrees. Wing suctions will not be required in narrow compartments at the ends of the vessel.

(*b*) In vessels having only one hold, and this over 110 feet in length, bilge suctions are to be fitted in suitable positions in the after half-length, also in the forward half-length, of the hold.

(*c*) Where close ceiling is fitted over the bilges, arrangements are to be made whereby water in a hold compartment may find its way to the suction pipes.

(*d*) Efficient means are to be provided for draining water from insulated chambers. (*See* **Section 3, clause 10, Rules for Refrigerating Machinery and Appliances of Ships.**)

(*e*) Where the inner bottom plating extends to the ship's side the bilge suctions may be placed either in a well the full width of the double bottom, or in wells placed at the wings and also at the centre line if the top plating has inverse camber.

The latter wells are to be formed of steel plates and the capacity of each well is not to be less than six cubic feet.

Steel bilge hats of reasonable capacity may be used where the spaces to be drained are of small dimensions.

(*f*) Where access manholes to bilge wells are necessary, they are to be fitted as near to the suction strums as practicable.

(*g*) Access to the bilge suction strum of a hold well should not be obtained by means of a manhole in the machinery space W.T. bulkheads, or tank top plating in the machinery space, if it be possible to avoid doing so.

Where, however, this arrangement is necessary, the manhole cover should be of hinged type and an instruction plate, in raised letters, should be affixed in a well-lighted position, to the effect that this door must be kept shut, except when access is required.

3. **Engine and Boiler Space Drainage.**—(*a*) Where the engine and boiler spaces are common and there is no double bottom, and the rise of floor is not less than 5°, one centre main bilge line and one independent power pump direct suction are to be fitted ; but, if the rise of floor is less than 5°, additional main line bilge suctions are to be fitted at the wings.

(*b*) Where the engine and boiler spaces are common and the double bottom extends the full length of the space, forming bilges at the wings, two power pump suctions (one of which may be an independent power pump direct suction) are to be fitted to the bilge on each side. Where the inner bottom plating extends to the ship's side three main bilge line suctions and an independent power pump direct suction are to be fitted, either in a well the full width of the double bottom or in wells, placed at the wings and also at the centre line where the top plating has inverse camber.

(*c*) Where the main engine room(s), the boiler room(s) or the auxiliary engine room(s) are separated by W.T. bulkheads, the number and position of the main bilge line suctions are to be the same as in the cargo holds.

In addition to the main bilge line suctions, an independent power pump direct bilge suction is to be fitted in each of the main and auxiliary engine rooms and boiler room(s).

(*d*) The main water circulating pumps are to be fitted with direct bilge suction connections, provided with non-return valves, to the lowest level in the machinery space and of a diameter at least two-thirds that of the sea inlet.

Where only one bilge injection is fitted, as in single screw vessels, this suction and the independent power pump direct bilge suction are to be fitted at opposite sides of the engine room, except in the case of a vessel having open floors in the machinery space and a rise of floor not less than 5°, when these suctions are to be fitted as near the centre line as practicable.

(*e*) The number of power driven bilge pumps is to be in accordance with the requirements of Section 4 of the Engine and Boiler Rules; but, in lieu of the bilge pump direct suction to the engine room referred to in clause 5 of that Section, a steam ejector suction of the same bore may be fitted.

4. **Fore and After Peak Drainage.**—(*a*) Where the peaks are fitted as water ballast tanks, a separate power pump suction is to be led to each. Where not used for water ballast and a main bilge line suction is not fitted, an efficient manual pump is to be fitted in the fore peak. Where the after peak is used as a ballast tank, no drain valve or drain cock is to be fitted to the bulkhead; but where not so used, it is to be drained by a manual pump or power pump suction, or by means of a self-closing cock in a readily accessible position. Where the flats above the peak tanks, or the chain locker are situated below the load water line, a manual pump or a power pump suction is to be provided.

(*b*) Where a suction pipe is led from the engine room to the fore peak, either through a hold space or through a tank intended to carry oil fuel, it is to be provided with a screw-down valve capable of being operated from an accessible position above the load water line, the chest being secured to the collision bulkhead inside the fore peak.

5. **Tunnel Drainage.**—(*a*) The tunnel well is to be fitted with a power pump suction.

(*b*) Where the tank top in the tunnel slopes from aft to forward, a bilge suction is to be provided at the forward end of the tunnel, in addition to the tunnel well suction required by paragraph (*a*).

6. **Pipe System.**—(*a*) The arrangement of valves and their connections are to be such as to prevent the possibility of water passing from the sea or from water tanks into the cargo or machinery spaces, or from one compartment to another. To effect this requirement, the bilge connection to any pump having also a suction from the sea should be made either by means of a non-return valve or a cock which cannot be open at the same time to the sea, or to water tanks and to the bilges. Valves in all bilge distribution boxes are to be of the non-return type.

Where connections are provided for bilge suction hoses, screw-down non-return valves are to be fitted at the branches to which the hoses are attached.

In the case of rotary pumps not having non-return valves incorporated in them, the direct bilge suctions are to be fitted with non-return valves.

(*b*) All cocks and valves in connection with bilge and ballast suction pipes, unless otherwise specifically mentioned in the Rules, are to be fitted in places where they are at all times accessible.

Bilge cocks, valves and mud-boxes are to be fixed in readily accessible places above the stokehold, engine room and tunnel platforms.

(*c*) All pipes from the pumps which are required for draining cargo or machinery spaces are to be entirely distinct from pipes which may be used for filling or emptying spaces where water is carried.

(*d*) Bilge suction pipes are not to be carried through double bottom tanks, deep tanks or oil fuel bunkers if it is possible to avoid doing so. Bilge pipes which pass through these tanks are to be of substantial strength and are to be tested, after fitting, to the same pressure as the tanks through which they pass.

(*e*) All suction and discharge pipes are to be efficiently secured in position and strapped to prevent lateral movement. The pipes are to be made in suitable lengths with flanged joints.

(*f*) Efficient expansion joints or bends are to be provided in each range of pipes and where the connections at bulkheads and other structural parts of the vessel are made with lead bends the radii of the bends and the distance between the axes of the straight parts of the pipe are each to be not less than three diameters, and the length of the bend is to be at least eight diameters of the pipe.

(*g*) The suctions in machinery spaces are to be led from easily accessible mud-boxes placed above the level of the working floor, with straight tail pipes to the bilges, and having covers secured in such a manner as to permit of them being expeditiously opened and closed. The suction ends in hold spaces are to be enclosed in strum-boxes having perforations not more than $\frac{3}{8}$ inch in diameter whose combined area is not less than twice that of the suction pipe, and the boxes are to be so constructed that they can be cleared without breaking any joint of the suction pipe. Suction pipes in tunnel wells are to have similar strum-boxes.

(*h*) Lead pipes are neither to be used within coal bunkers nor are they to be attached to bunker bulkheads, except in the case of steam tugs and tenders.

7. **Bilge Pumps.**—(*a*) Each power bilge pump is to be arranged to draw water from any hold or machinery compartment of the vessel, except where manual pumps only are permissible.

(*b*) Each power bilge pump required by **Section 4** of the **Rules for Engines and Boilers,** is to be capable of giving a speed of water through the pipes of the largest diameter required by the formula (**clause 9**) of not less than 400 feet per minute, under ordinary working conditions. Where, however, two bilge pumps are worked from the main engines, the capacity of each main engine bilge pump may be half that required above.

Alternatively, the capacity of the main engine bilge pumps may be less than that required above, provided the deficiency be made good by the independent power pump connected to the main bilge line.

(*c*) All power pumps which are essential for bilge service are to be of self-priming type.

(*d*) Manual pumps are at all times to be workable from a position above the load water line.

8. **Watertight Bulkhead Fittings.**—(*a*) No drain valve or drain cock is to be fitted to the collision bulkhead.

(*b*) No drain valves or drain cocks are to be fitted to the engine and boiler room bulkheads, or other watertight bulkheads, unless they are arranged so as to be accessible at all times and are so geared that they may be shut off from a position above the load water line.

(*c*) Where owners desire to fit non-return valves to bilge suction pipes in order to decrease the risk of flooding after damage, such valves are to be of an approved pattern.

(*d*) In the case of deep tanks which may be used for either water ballast or cargo, provision is to be made for blank flanging the water ballast filling and suction pipes when the tank is being used for cargo, and for blank flanging the bilge suction pipes when the tank is being used for water ballast.

(*e*) Valve chests, cocks, pipes, and other fittings attached to the bulkheads or to the tunnel plating are to be secured by means of studs screwed through the plate, or by tap bolts, and not by bolts passed through clearing holes.

9. **Diameters of Bilge Suction Pipes.**—(*a*) The inside diameters of bilge suction pipes, in inches, are to be in accordance with the following formulæ to the nearest quarter inch.

$$\sqrt{\frac{L\,(B + D)}{2500}} + 1 \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

for main bilge line suctions and direct bilge suctions to the pumps, but in no case are these suctions to be less than the size required for the branch bilge suction to any one compartment.

$$\sqrt{\frac{C\,(B + D)}{1500}} + 1 \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

for branch suctions to cargo and machinery spaces,

where L = length of vessel, in feet.
B = breadth of vessel, in feet.
D = moulded depth to bulkhead deck, in feet.
C = length of compartment, in feet.

(*o*) No main suction pipe is, however, to be less than 2 inches in bore, and no branch pipe is to be less than 2 inches in bore, or need be more than 4 inches in bore.

(*c*) The area of each branch pipe connecting the bilge main to a bilge distribution chest is to be not less than the combined area of the two largest branch bilge suction pipes connected to that chest, but need be not greater than the size required for the bilge main suction pipe.

(*d*) Bilge suction pipes to fore and after peaks, and to the tunnel well, are to be not less than $2\frac{1}{4}$ inches in bore, except in vessels not exceeding 200 feet in length, in which case they may be 2 inches in bore.

10. **Air Pipes.**—(*a*) Air pipes are to be fitted at the outboard corners of the water ballast tanks at the opposite end of the tank to that at which the filling pipes are placed, or at the highest part of the tank.

(*b*) Air pipes are to be led to above the load water line, and their openings are to be provided with satisfactory arrangements to prevent the free entry of water.

(*c*) In the case of tanks which can be pumped up, the total cross sectional area of the air pipes is to be not less than that of the respective filling pipes.

(*d*) Where air pipes extend above the freeboard or superstructure decks, the height from the deck to the opening is to be at least 36 inches in wells on freeboard decks, 30 inches on raised quarter decks, and 18 inches on other superstructure decks which are immediately above the freeboard deck.

11. **Sounding Pipes.**—(*a*) All water spaces and compartments, except the main engine and boiler compartments, are to be provided with straight open-ended sounding pipes, fitted as near as practicable to the pump suctions.

(*b*) Doubling plates, or their equivalent, are to be fitted under all sounding pipes for the rod to strike upon.

(*c*) Sounding pipes, including those for the double bottoms below machinery spaces, should extend to positions, above the load water line, which are at all times accessible.

Where this arrangement is not practicable, short sounding pipes may be fitted in machinery spaces and tunnels, provided these pipes be led to readily accessible positions above the platforms and be furnished either with non-detachable screw caps or with shut-off cocks.

(*d*) No sounding pipe is to be less than $1\frac{1}{4}$ inches bore.

(*e*) In the case of insulated holds, sounding pipes are to be provided both above and below the insulation. When the hold temperatures contemplated are lower than 33° F. the sounding pipes are to be not less than $2\frac{1}{2}$ inches bore.

These sounding pipes are to be insulated efficiently. (*See* **Section 3, clauses 9** and **11, Rules for Refrigerating Machinery and Appliances.**)

(*f*) Where elbow sounding pipes are fitted, they are to be efficiently supported and of substantial thickness in order to withstand the use of the sounding rod.

12. **Protection of Pipes.**—All air and sounding pipes, suction and discharge pipes, and scupper and soil pipes are to be effectively protected where necessary against risk of damage from cargo or coal.

13. **'Tween Deck Scupper Pipes.**—'Tween deck scupper pipes are to be fitted in accordance with the requirements of **Section 29, clause 2.**

14. **Vessels Fitted for Burning and Carrying of Oil used as Fuel.**—The requirements of **Section 20** are also to be complied with.

15. **Sailing Vessels.**—Hand pumps are to be fitted in number and position as may be required for the efficient draining of the vessel. The pumps are to be capable of being worked from the upper deck or from above the load water line, and the bottoms of the pump chambers are not to be more than 24 feet above the suction rose.

The sizes of the hand pumps are not to be less than given in the following Table:—

Tonnage under Upper Deck.	Hand Pumps.	
	Diameter of Barrel.	Diameter of Tail Pipe.
	Inches.	Inches.
Not exceeding 500 tons	4	2
Above 500 tons but not exceeding 1,000 „	$4\frac{1}{2}$	$2\frac{1}{4}$
„ 1,000 „ „ 2,000 „	5	$2\frac{1}{2}$
„ 2,000 tons	$5\frac{1}{2}$	$2\frac{3}{4}$

16. **Vessels employing Electric Propulsion.**—The requirements of **Section 5, clause 13, paragraph** (*b*) of the **Rules for Electric Propelling Machinery,** are to be complied with.

SAILING VESSELS.

Section 35. 1. **General.**—Sailing vessels are to be constructed in accordance with the rules and regulations for steamers, with the exceptions contained in the following clauses.

2. **Framing.**—(*a*) All reversed frames are to extend to the upper deck.

(*b*) Sailing vessels above 20 feet, and not exceeding 33 feet moulded depth, are to have one tier of beams below the upper deck, spaced not more than two frame spaces apart, or equivalent transverse stiffening is to be provided.

(*c*) Sailing vessels above 20 feet, and not exceeding 27 feet moulded depth, are to have a deep web frame, of the breadth and thickness of the second deck stringer plate, fitted in way of each mast, and connected to the outside plating with double angles. These web frames are to extend to the upper deck, and are to be provided with efficient lateral support.

(*d*) Where the moulded depth is above 27 feet, and does not exceed 33 feet, instead of the deep web frames prescribed in the preceding paragraph, partial bulkheads, with efficient lateral support, are to be fitted in way of each mast.

3. **Panting Arrangements.**—In addition to the panting arrangements required by **Section 7,** panting beams and stringers are to be fitted at the after end of the vessels where the moulded depth exceeds 15 feet.

4. **Beams.**—Where the length of the midship beam does not exceed 30 feet, the upper and second deck beams are to be $\frac{1}{2}$ inch deeper than given in **Tables 12** and **13** for upper deck beams of the same length in steamers where one

tier of beams only is fitted; and where the length is above 30 feet the upper, second, and third deck beams are to be one inch deeper than given in the Tables. The depths of the beam knees are to be correspondingly increased.

5. **Bulkheads.**—In sailing vessels only the foremost or collision bulkhead will be required, and it is to be placed at not less than one-tenth the vessel's length abaft the fore part of the stem.

6. **Decks.**—(*a*) In vessels which are not required to have complete steel decks, the decks in way of the masts are to be plated from side to side of the vessel.

(*b*) The thickness of wood decks is not to be less than $3\frac{1}{2}$ inches, and the margin planks of the weather deck are to be of either teak or greenheart.

7. **Bulwark Stanchions.**—The stanchions which support the bulwarks are not to be spaced more than 5 feet apart. Where stanchions are fitted on the butt straps of the bulwark plating, the straps are to be sufficiently broad to receive the spur in the middle of the stanchion, and the bulwark plating is to be doubled or fitted with vertical straps in way of the intermediate stanchions. The heel of each stanchion is to be attached by not less than four $\frac{7}{8}$ inch bolts. Their size may be from $1\frac{3}{8}$ inches to 2 inches in diameter, regulated by the length of the stanchion and the size of the vessel.

8. **Mast Rings.**—The mast rings are to be formed of bulb angle of suitable size.

9. **Equipment.**—(*a*) Where a sailing vessel has a poop bridge, top-gallant-forecastle, or a raised quarter-deck, the equipment number is to be increased one-fifteenth above that for a flush-deck vessel.

(*b*) One of the bower anchors must have the weight required by the Tables, but otherwise the weights of bower anchors may be regulated in accordance with **Section 39, clause 4** (*a*).

10. **Strengthening of Bottom Forward.**—The requirements of **Section 11** of the Rules do not apply to Sailing Ships.

MASTS, SPARS AND RIGGING.

Section 36. Sailing Vessels. 1. Lower Masts.—(*a*) The scantlings of lower masts are to be as given in **Table 49** and the length of the mast is to be measured from the deck to the hounds.

(*b*) The mizzen masts of barques may be reduced one-fifth in diameter from that given in the Table, and the thickness of the plating may be in accordance with the reduced diameter.

(*c*) The diameter of the lower mast at the cap is not to be less than that of the heel of the topmast, nor less than the greatest diameter of the lower topsail yard at centre.

(*d*) Where angle stiffeners are required these stiffeners are to be fitted for the full length of the masts.

(*e*) The butts of the plating are to be treble riveted above the mast partners; elsewhere they may be double riveted. The seams are to be double riveted throughout.

(*f*) Where pole masts are fitted, the length for determining the scantlings of the lower mast is to be taken from the deck to the hounds. In such masts additional strengthening is to be provided from below the lower yard to above the normal position of the lower mast cap.

(*g*) Doubling plates are to be fitted in way of the mast wedging and where masts are wedged at more than one deck, the doubling plates are to extend from below the lower to above the upper wedging.

(*h*) The heels of all masts and their steps are to be efficiently strengthened.

2. **Topmasts.**—(*a*) The length of the topmast is to be measured from the lower mast cap to the topmast hounds.

(*b*) The plating is to be of the thickness given in **Table 50.** The butts are to be treble riveted and the seams may be single riveted.

(*c*) The diameter of the topmasts at the lower cap, sheave hole and topmast cap is not to be less than that of the yards at these places.

(*d*) Doublings are to be fitted in way of the lower mast cap, in way of the fid holes and in way of the sheave holes where such are cut, and at the head.

(*e*) Efficient cheek plates are to be fitted to topmasts whose length exceeds 24 feet.

3. **Topgallant Masts.**—The diameter of the topgallant mast is not to be less than the diameter of the topgallant yard.

4. **Yards.**—(*a*) The diameter of the yards and the thickness of the plating are to be in accordance with **Table 50.** The butts are to be double riveted and the seams single riveted.

(*b*) The plating is to be doubled in way of cleats and at the centre to beyond the truss hoops.

(*c*) Topsail and topgallant yards, where of pitch pine, are not to be less in diameter than $\frac{1}{4}$ inch per foot of length.

5. **Bowsprits.**—(*a*) The thickness of the plating is to be as given in **Table 49.**

(*b*) Doubling plates are to be fitted in way of the bowsprit wedging.

(*c*) Bowsprits exceeding 28 inches in diameter are to have a vertical diaphragm plate extending from within the wedging to beyond the bobstay band, connecting the upper and lower parts of the bowsprit, and, in addition, two angle stiffeners of the size given in the Table are to be fitted. Bowsprits 28 inches and under in diameter are to have angle stiffeners, extending the full length of the bowsprit, at the centre of each plate. The butts are to be double riveted and the seams single riveted.

6. **Steamers.**—(*a*) The length for determination of scantlings is to be measured from the deck to the hounds.

(*b*) The scantlings of the masts are to be in accordance with **Table 47,** and these scantlings are considered suitable for the support of average equipment of derricks of normal outreach provided the staying of the masts is efficient.

(*c*) Masts which are not intended to carry derricks may be 20 per cent less in diameter than required by **Table 47,** and the thickness of the masts may be in accordance with the reduced diameter.

(*d*) The butts of the plating are to be treble riveted above the mast partners, and the seams are to be single riveted.

(*e*) Doubling plates are to be fitted at the heel, at the wedging, in way of the derrick supports, and at the hounds. The length of these doublings is not to be less than the maximum diameter of the mast.

7. **Rigging.**—(*a*) The shrouds and stays for steamers and sailing ships are to be in number and size as required by **Tables 48** and **51,** and they are to withstand the tests specified.

(*b*) Chain plates are to be securely connected to the structure of the vessel which is to be efficiently stiffened for this purpose where necessary.

(*c*) All smith work for masts, spars and rigging is to be of the best description of wrought iron, and particular attention is to be paid to workmanship.

8. **Lightning Conductors.**—Lightning conductors are to be fitted in accordance with the requirements of **Section 19** of the **Rules for Electrical Equipment.**

TUGS.*

Section 37. 1. **General.**—The scantlings and arrangements of Tugs for which the Class 100A1 "For Towing Services" is desired, are to be as required by the Rules and Tables, except where specified otherwise in this Section.

2. **Floors.**—(*a*) The floors, if desired, may be flanged $3\frac{1}{2}$ inches on the upper edge, in lieu of reversed bars, except in the engine room and under boiler bearers.

(*b*) Where the bottom of the vessel is filled solid with cement to the level of the top of the floors, the fitting of reversed frames, or the flanging of the floors, may be dispensed with.

3. **Keelsons.**—The scantlings of the keelsons are to be in accordance with the requirements of **Table 11.**

4. **Bulkheads.** — The scantlings of the bulkhead stiffeners and plating are to be in accordance with the requirements of **Tables 29** and **31.** Bracket or lug attachments need not be fitted at the ends of the stiffeners.

5. **Decks.**—The deck is to be completely plated over abreast the machinery openings.

6. **Machinery Casings.**—(*a*) The machinery casings are not to be less in height than 3 feet above the top of the deck, and are to extend to the underside of the deck beams. The casings are to be connected to the deck plating with angle bars, and to the ends of the half beams with angle lugs. If the casings are not extended to the underside of the beams, they are to be attached to the deck plating by a double riveted angle bar, or the deck plating may be turned up the casing side and double riveted thereto.

(*b*) Machinery casings are to be hose tested on completion to ensure water-tightness.

(*c*) A strong through beam is to be fitted at the deck level at the middle of the length of the machinery opening, and, if practicable, should be associated with webs on the sides of the casing.

7. **Hatchways.**—Hatch coamings are not to be less than 12 inches in height, and the covers and battening arrangements are to comply with the requirements of **Section 25.**

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*NOTE.—**Trawlers.**—*The Society's requirements regarding the Construction and Classification of Steel Trawlers are published separately.*

8. **Rudders.**—The diameter of the rudder head is to be increased half-an-inch beyond that required by **Table 41**, and all the scantlings of the rudder are to be in accordance with the increased diameter.

9. **Equipment.**—The equipment for Tugs is to be as given in **Table 55**. The equipment to be supplied to vessels of this type is to be regulated by the second longitudinal numeral $L \times (B+D)$, without any addition for casings or other erections.

10. **General.**—The requirements of **Section 7** and **Section 11** do not apply to Tugs.

WORKMANSHIP.

Section 38. 1. General.—The workmanship is to be well executed and submitted to the closest inspection.

2. **Treatment of Material.**—(*a*) Cementing or painting is to be delayed as long as possible so that the removal of the black oxide or mill scale may be facilitated.

(*b*) Experience has shown that, as regards durability, it is highly desirable to place steel vessels in dry dock within a reasonably short period after being launched for the purpose of cleaning and re-coating the bottom.

3. **Riveting.**—(*a*) Rivet holes are to be regularly spaced and are to be carefully punched from the faying surfaces wherever possible.

(*b*) Rivet holes are to be properly formed and the burr caused by punching removed before the parts are fitted together for riveting.

(*c*) The rivet holes at the turn of the bilge in frames are not to be punched until the frames are bent to the required shape.

(*d*) Before riveting is commenced the work is to be carefully closed with nut and screw bolts, which are to be spaced sufficiently close to draw the parts together effectively.

(*e*) Unfair holes are to be properly rimered and re-countersunk if necessary and are not to be cut with a chisel or unduly drifted.

(*f*) The rivets are to be staved up so as to fill the holes completely, and their heads are to be properly laid up. The points are to be left full, but are not to be spread over the plating.

(*g*) The punches and dies are to be maintained in satisfactory condition.

4. **Joggling and Lining Pieces.**—(*a*) Where plates or bars are joggled, care is to be taken to ensure that the depth of joggle is the same as the thickness of the adjacent plating.

(*b*) Where lining pieces are fitted they are to be in one piece and are to be of the same breadth as the flange of the frames.

5. **Caulking.**—Caulking is to be carefully and thoroughly executed.

EQUIPMENT.

Section 39. 1. **Notation.**—The figure **1** placed after the character assigned to a vessel indicates that the equipment is considered to be suitable and is in good and efficient condition.

2. **Equipment Number.**—The equipment of anchors, chains, hawsers, and so forth, is to be regulated by the second numeral $L \times (B + D)$ as defined in Section 3, except that in complete superstructure vessels, D is to be the actual depth to the superstructure deck.

An allowance for superstructures is to be added as follows:—

(*a*) For a raised quarter deck the product of the height and length in feet.

(*b*) For a poop, bridge, or forecastle, three-fourths the product of the height and length in feet.

(*c*) For deckhouses or other erections which do not extend to the side of the vessel but which exceed, either in length or breadth, one-half the breadth of the vessel, one-half the product of the height and length in feet.

3. **Testing of Equipment.**—(*a*) All anchors and cables are to be tested at a public machine recognised by the Committee and in accordance with the requirements of **Sections 12, 13 and 14 of the Rules for the Testing of Materials.**

(*b*) In the case of vessels whose anchors and chains have been tested at one of the recognised Proving Establishments in Great Britain and Ireland, the notation "Lloyd's A&CP" will be made in the Register Book.

(*c*) In the case of vessels of other than British Registry classed with the figure **1**, in which the anchors, chains, or both, have been tested under the inspection of the Society's Surveyors at Proving Establishments out of Great Britain and Ireland recognised by the Committee, and test certificates are furnished, duly signed by the Society's Surveyors, the vessel will have recorded in the Register Book the notation "Lloyd's A&CP," "Lloyd's AP," or "Lloyd's CP," as the case may be.

(*d*) Where, however, the anchors or chains for vessels of other than British Registry are manufactured out of Great Britain and Ireland, and test certificates are furnished setting forth that they have been tested at a Government machine, or at a machine under the control of a municipal body or a similar responsible body, but not under the inspection of a Surveyor to the Society, the record of Lloyd's A&CP, and so forth, will not be made in the Register Book, though such certificates will be accepted as satisfying the requirements of the Rules as regards tests in assigning the figure 1.

(*e*) Certificates stating that all anchors and chains have been tested, and giving particulars of the loads applied, are to be produced before the ship is classed with the figure 1.

4. **Equipment.**—(*a*) All vessels classed 100A1, or 100A1 "with freeboard," are to be provided with anchors, cables, and hawsers, in number, weight and length as set forth in **Tables 53** and **54**. Provided the collective weight of the bower anchors is not less than required by the Tables, then :—

(1) The bower anchors may be of equal weight ; or

(2) Where three bower anchors are required, one of them may be 15 per cent and another 7½ per cent lighter than the weight required by the Tables ; or

(3) Where only two bower anchors are required, one of them may be 7½ per cent lighter than the weight required by the Tables.

The weights of cables include two end shackles to each cable (*i.e.* four end shackles for each outfit which contains two cables), and two end shackles to each stream chain.

(*b*) In the case of vessels classed A "For Special Services," the equipment is to be as required by the Committee, having in view the particular trade in which the vessel is to be engaged.

(*c*) To entitle vessels classed A "For Channel Purposes" to the figure 1, the equipment of anchors, chains, and so forth, is to be as required by **Table 53**, except that not more than two bower anchors and one stream anchor need be supplied. The first bower anchor is to be of the full weight required by the Table and the second bower may be 15 per cent lighter. This rule, however, applies only to vessels intended for short voyages.

(*d*) In vessels classed "For Channel Purposes," which are intended for longer voyages, such as the Queenboro-Flushing, the Channel Islands or the Irish Sea service, the equipment is to be in accordance with the requirements of the Tables.

(*e*) The equipment for Tugs is to be as given in **Table 55**, the equipment numeral being computed as described in **Section 37, clause 9.**

(*f*) The diameter of stud chain cable given in **Tables 53, 54** and **55** applies to cables of wrought iron. Steel cables, of material of higher tensile strength, made by an approved process may be reduced in diameter from those given in the tables as shown below.

Tabular Size.	Reduction.
Inches.	Inches.
$\frac{14}{16} - \frac{15}{16}$	$\frac{1}{16}$
$1 - 1\frac{3}{16}$	$\frac{2}{16}$
$1\frac{4}{16} - 1\frac{10}{16}$	$\frac{3}{16}$
$1\frac{11}{16} - 2\frac{1}{16}$	$\frac{4}{16}$
$2\frac{2}{16} - 2\frac{9}{16}$	$\frac{5}{16}$
$2\frac{10}{16} - 3\frac{2}{16}$	$\frac{6}{16}$
$3\frac{3}{16} - 3\frac{8}{16}$	$\frac{7}{16}$

The tests for cables are to be as required in **Section 14** of the **Rules for the Quality and Testing of Materials.**

5. **Anchors and Chains.**—(*a*) The anchors and the links of the chains are not to be of exceptionable form or proportions.

(*b*) All anchor stocks are to be of acknowledged and approved description and equal to one-fourth the specified weight of the anchor.

(*c*) The heads of stockless anchors are to be not less than three-fifths of the total weight of the anchor.

6. **Renewal of Chain Cable when worn.**—When any length of chain cable is so worn that the mean diameter at its most worn part is reduced to the size given in **Table 56** it is to be renewed.

7. **Windlass and Hawsepipes.**—(*a*) A substantial windlass is to be fitted of suitable size for the cable, and is to be efficiently secured. Stiffening under windlass is to be provided as required by **Section 16.**

(*b*) Hawsepipes are to be of sufficient size and thickness, and the arrangements such as to admit of an easy lead for the cable to the windlass or capstan.

8. **Boats.**—All vessels not exceeding 150 tons are to be provided with one good boat, and every vessel above 150 tons is to have a suitable number of boats.

The Surveyors are to examine and to report on the condition of the boats.

9. **Anchor Cranes and Boat Davits.**—(*a*) The sizes of the principal parts of anchor cranes are to be in accordance with **Table 52,** and the outreach of the cranes is to be sufficient to swing the anchors well clear.

(*b*) In the cases of boats and davits of ordinary proportions the diameter *d*, in inches, of the davit is to be obtained by using the formula :—

$$d = \sqrt[3]{\frac{L \times B \times D\,(H + 48)}{C}}$$

where L, B and D are the length, breadth and depth respectively of the boat, H is the height of the davit above its uppermost point of support, and S is the outreach of the davit ; each of these distances being in feet.

The value of the constant C is to be as follows :—

(1) When the davit is to be of wrought iron and of sufficient strength to carry the boat and its equipment, and a sufficient number of men to launch it, the value of C is to be 144.

(2) When the davit referred to in (1) is to be of wrought ingot steel from 27 to 32 tons per square inch tensile strength, the value of C is to be 174.

(3) When the davit is to be of wrought iron and of sufficient strength to lower safely the boat fully equipped and carrying the maximum number of persons for which it is intended, the value of C is to be 86.

(4) When the davit referred to in (3) is to be of wrought ingot steel of from 27 to 32 tons per square inch tensile strength, the value of C is to be 104.

(*c*) Boat and anchor davits may be approved of weldless rolled or drawn steel tubes of the equivalent sizes given in **Table 52,** provided the steel of which the davits are made has a tensile strength of not less than 35 tons per sq. in. with an elongation of not less than 10 per cent in a length of 8 ins.

(*d*) The davits are to have solid heels and are to be efficiently strengthened in way of the heads and deck supports.

10. **Notation Withdrawn.**—Where the equipment is not in accordance with the requirements of the Rules, a dash thus –, will be inserted in place of the figure 1. In cases where the figure 1 is expunged on account of deficiencies in the anchors or chains, the record of Lloyd's A&CP will also be expunged.

STRENGTHENING FOR ICE NAVIGATION.

Section 40. 1. **Framing** :—(*a*) Forward of the collision bulkhead, intermediate frames are to be fitted extending from below the level of the floors to the deck next above the load waterline, with scantlings as required by **Tables 2** or **3** for angle frames in peaks, but with thickness ·10 inch greater.

(*b*) Abaft the collision bulkhead all the main frames for a distance from the stem equal to 15 per cent of the length of the vessel are to be in accordance with the requirements of **Section 7, clause 2,** and as required for Complete Superstructure Vessels in **Table 5.** The attachments at the ends of these frames are to be as required by **Section 7, clause 2.**

Intermediate frames of scantlings required by **Table 4** for bulb angle frames in peaks are to be fitted extending aft from the stem for a distance equal to 20 per cent of the length of the vessel where the length does not exceed 200 feet graded to 15 per cent of the length of the vessel where the length is 400 feet and above.

These intermediate frames are to extend either from the margin plate, or in single bottom vessels from below the tops of the floors, to the deck next above the load waterline ; they need not be connected at their ends.

In Full Scantling vessels, however, the strength and stiffness of the side framing are not to be less than required by **Section 7, clause 2** of the Rules.

(*c*) The intermediate frames required above may be dispensed with provided the frame spacing is reduced to 18 inches and the scantlings of the side framing are made equivalent in strength and stiffness. This reduced frame spacing is to extend aft for the distance prescribed in paragraph (*b*).

(*d*) The breadth of the shell flange of the frames is to be suitable for the increased thickness of shell plating required by this Section.

2. **Shell Plating.**—(*a*) From 1 foot above the load line to 4 feet below the light line, and in a fore and aft direction from the stem to a point at least as far aft as the extent of the reinforced framing, the shell plating is to be fitted of a thickness equal to that required by **Table 18** of the Rules for side shell plating amidships increased by 40 per cent if intermediate frames are fitted, or by 55 per cent if a frame spacing of 18 inches is adopted ; the increased thickness of shell plating need not exceed 1 inch. The shell plate in each strake immediately abaft this point is to be intermediate

in thickness between the full amount required for ice strengthening under this clause and the normal thickness of side shell plating.

(*b*) Seams of shell plating from 1 foot above the load line to 4 feet below the light line are to be at least double riveted for a distance aft of the stem equal to 25 per cent of the vessel's length, where the length does not exceed 200 feet, graded to 15 per cent of the length of the vessel where the length is 400 feet and above.

3. **Stringers.**—Side stringers are to be fitted forward and aft of the collision bulkhead in accordance with the requirements of **Section 7** of the Rules. The stringers are to be carried aft to the normal thickness of side plating.

4. **Rudder and Steering Arrangements.**—The diameter of the rudder head is to be increased 15 per cent above the Rule requirements where the Rule diameter is less than 8 inches, and by 10 per cent where the Rule diameter is 8 inches or above. The scantlings of the rudder, rudder quadrant and tiller, and the diameter of the steering chains and rods are to be in accordance with the increased diameter of rudder head.

5. **Screw Shaft.**—The diameter of the screw shaft is to be increased 5 per cent above that required by the Rules.

6. **Propeller Blades.**—The propeller blades are to be made of cast steel, or other approved material.

Where bronze is used for propellers or propeller blades it is to comply with the requirements of **Section 11** of the **Rules for Quality and Testing of Materials.**

7. **Ship Side Valves.**—Sea inlet valves and overboard discharge valves below the maximum load water line are to be provided with connections from the boiler, or air receiver where no boiler is fitted, for clearing purposes.

The scantlings of the valves are to be suitable for the maximum pressure to which they will be subjected.

8. **Plans to be Submitted.**—Where it is desired that a vessel should receive the notation for ice strengthening (*see* par. (*g*), page 9), plans showing the proposed arrangements should be submitted for the approval of the Committee.

GENERAL.

Section 41. 1. **Equivalents.**—Any arrangement or fitting which, in the opinion of the Committee, is in all respects as efficient as that required by the Rules may be accepted instead of such arrangement or fitting.

The Owners' consent to the adoption of any proposed equivalent is to be obtained where considered necessary by the Committee.

2. **Interpolation.**—For numerals and dimensions intermediate between those given in the Tables, scantlings are to be obtained by proportional interpolation.

For a particular numeral the Table gives the minimum requirements and where a numeral is in excess of a Table numeral, the scantling to be taken is to be the nearest practicable above the requirements for the Table numeral.

3. **Gradual Reductions.**—(*a*) Where scantlings are required to be adopted over a proportion of the vessel's length, any reductions which may be permitted toward the ends of the vessel are to be effected gradually.

(*b*) Care is to be taken as far as possible to avoid any abrupt changes or discontinuities in the form of the structure, and where such occur suitable structural compensation is to be provided.

4. **Buttstraps to Continuous Longitudinal Angles.**—Buttstraps need not be fitted to continuous longitudinal angles which serve simply as connecting bars, except in the case of the stringer bars on strength decks.

5. **Items not Particularly Specified.**—Where special reference is not made in the Rules to specific requirements, the construction is to be reasonably efficient for the intended service and is to conform to good average practice.

71, Fenchurch Street, London, E.C.3.
28th November, 1946.

VESSELS INTENDED

TO

CARRY PETROLEUM IN BULK.

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RULES FOR THE CONSTRUCTION OF VESSELS INTENDED TO CARRY PETROLEUM IN BULK.

The attention of Builders and Owners is directed to the fact that compliance with these Rules may involve the obtaining of licences under existing patents.

NOTE.—**The Tables referred to herein are those appearing on pages 473 to 526** (*Printed in blue*).

GENERAL.

Section 1. 1. **Application.**—The "**General Regulations relating to the Classification of Steel Vessels**" and the "**Rules for the Building of Steel Vessels**" determine the scantlings, arrangements and equipment of vessels intended for the carriage of petroleum in bulk, except as otherwise required by these Rules and Tables.

The Rules are framed for vessels built on the longitudinal system of construction, having a centre line bulkhead, continuous expansion trunk between the upper and second decks, and a standard 'tween deck height of 8 feet.

Approval will be given to vessels built on other systems of construction subject to equivalent strength being provided.

The propelling machinery is assumed to be situated at the after end of the ship.

2. **Submission of Plans.**—In addition to the plans required by **Section 1** of the "**Rules for the Building of Steel Vessels,**" there are to be submitted for approval plans showing:—

(*a*) The arrangement of oil tanks and cofferdams;

(*b*) The construction of the transverse and longitudinal bulkheads;

(*c*) The bracket attachments of the transverses, the webs, the longitudinals and the horizontal stiffeners; and

(*d*) The construction of the vessel at the forward and after ends, including the machinery space and the arrangements at the junction of the transverse and longitudinal framing.

3. **Length of Oil Compartments.**—The Rules are framed for a length of the main oil compartments not exceeding 30 feet, and for a length of the summer tanks not exceeding 60 feet.

4. **Expansion Trunks.**—Continuous expansion trunks are to be fitted between the upper and second decks. Where the breadth of the expansion trunk exceeds 60 per cent of the breadth of the vessel, the arrangements are to be specially submitted for approval.

5. **Cofferdams.**—Cofferdams are to be fitted at the forward and after ends of the oil cargo spaces. The cofferdams are to be not less than 3 feet in length, and are to extend from the keel to the top of the continuous expansion trunk.

6. **Deck Erections.**—Vessels are to have forecastles the length of which is not to be less than seven per cent of the length of the ship.

A poop is to be fitted, adequately covering the machinery space, and the bulkhead at the front of the poop is to have the scantlings required for bridge front bulkheads.

Any openings in this bulkhead are to have sills not less than 18 inches in height and are to be fitted with effective closing appliances.

Where a poop is proposed to be dispensed with, plans showing the construction of the casings and deckhouses are to be submitted for approval.

The doors in exposed machinery casings on the poop deck are to be of steel, substantially constructed, permanently attached and capable of being closed and secured from both sides.

7. **Cement.**—Cementing may be dispensed with in compartments intended for carrying oil in bulk.

8. **Rudders.**—The diameter of the rudder head is to be increased 10 per cent above the requirements of the **Rules for the Building of Steel Vessels**, and all the scantlings of the rudder are to be in accordance with the increased diameter.

9. **Freeing Arrangements.**—Ships with bulwarks are to have open rails fitted for at least half the length of the exposed portion of the weather deck.

Where superstructures are connected by trunks, open rails are to be fitted for the whole length of the weather portions of the freeboard deck.

BOTTOM TRANSVERSES.

Section 2. 1. **Scantlings.**—(*a*) The scantlings of the bottom transverses are to be as given in **Table 1**, and the upper edge of the transverse is to be parallel to the rise of floor line.

(*b*) The face bars on the transverses are to extend between the inner edges of the side transverses and of the bulkhead webs, and as close as practicable to the centre line bulkhead on the side opposite to the vertical webs.

(*c*) The scantlings determined for the midship tanks are to apply throughout the oil compartments.

(*d*) Lightening holes, not exceeding 10 inches in diameter, may be cut in the transverses, and are to be fitted midway between the notches for the longitudinals.

(*e*) Notches cut in the transverses for longitudinals are to be well rounded at the corners and are not to be rough punched.

2. **Bracket Attachments.**—(*a*) The distance from the ship's side and from the centre line bulkhead to the toe of the bracket is to be 10 per cent of the midship breadth of the vessel where this breadth is 30 feet, and 16 per cent where the breadth of the vessel is 70 feet, intermediate values being obtained by interpolation. The length of the vertical arm is to be as specified in **Section 3, paragraph 2** (*a*).

The brackets on the side of the centre line bulkhead opposite to the vertical web are to have the same dimensions, measured from the bulkhead and from the base line in each case, as are required for the brackets on the same side of the bulkhead as the vertical web.

(*b*) The thickness of the brackets is to be the same as that of the transverses.

(*c*) The brackets are to be flanged 5 inches on the edge. Where the length of the bracket along the edge exceeds 66 inches, stiffening angles $3\frac{1}{2} \times 3$ inches, of the same thickness as the bracket are to be fitted. Where the thickness of the bracket exceeds ·50 inch these angles are to be $3\frac{1}{2} \times 3\frac{1}{2}$ inches.

(*d*) The brackets are to be attached to the centre line bulkhead by a single angle, double riveted, which is to have the same thickness as the bracket plate. In vessels exceeding 420 feet in length where the spacing of transverses, in feet, multiplied by the length of the vessel, in feet, exceeds 4,300, and in all vessels exceeding 480 feet in length, these bars are to be doubled.

In the case of vessels between 420 and 480 feet in length, in which this product does not exceed 4,300, the brackets are to be attached to the centre line bulkhead by a single angle, double riveted, on one side of the bracket and a single riveted angle on the other side of the bracket.

(*e*) The brackets are to be attached to the transverses by double riveted overlaps. Where the brackets extend to the shell the overlaps are to be treble riveted, except where the overlap comes in way of a longitudinal, when it is to be quadruple riveted.

(*f*) The overlaps of the plates of the transverses are to be kept clear of the shell longitudinals as far as possible.

3. **Shell Attachment.**—(*a*) The angles attaching the transverse to the shell are to have the same thickness as the transverses.

(*b*) In vessels in which the spacing of transverses in feet, multiplied by the length of the vessel in feet, does not exceed 4,300, the transverses are to be attached to the shell by a single angle, double riveted. In all vessels whose length is greater than 480 feet and in vessels not exceeding 480 feet in length where the spacing of the transverses multiplied by the length of the vessel exceeds 4,300, an additional single riveted back bar is to be fitted.

4. **Stiffeners and Attachments to Longitudinals.**—(*a*) Each longitudinal is to be attached to the transverses by an angle which is to extend from the shell to the inner edge of the face bar and to half the height of the transverse alternately, but not lower than to the top of the lightening holes.

(*b*) These angles are to have scantlings in proportion to the tabular depth of transverse as prescribed by **Table 3.**

(*c*) The number and diameter of the rivets in the angles connecting the longitudinals to the transverse are to be in accordance with **Table 12.**

Where by the Table the broader flange of long stiffening angles exceeds 5 inches the number and diameter of the rivets are to be as required for 6 inch stiffening angles.

The diameter of the rivets in the short stiffening angles is to be the same as required for the rivets in the long stiffening angles.

(*d*) Where the breadth of the vessel does not exceed 40 feet the transverse is to be supported by a bracket at about the quarter breadth of the vessel.

Where the breadth of the vessel exceeds 40 feet, but does not exceed 60 feet, each transverse is to be supported by two brackets which are to be arranged on longitudinals adjacent to the toes of the transverse brackets.

Where the breadth exceeds 60 feet an intercostal girder, as required by **Section 5, clause 2,** and two brackets are to be fitted.

(*e*) Where the flange of the face bar exceeds 7 inches in breadth, at least two vertical supports are to be connected to the face bar.

SIDE TRANSVERSES.

Section 3. 1. **Side Transverses in Hold.**—(*a*) The side transverses are to be fitted in conjunction with the bottom transverses and the scantlings are to be determined by the spacing of the transverses by the depth of the vessel, and by a depth "d" which is measured amidships from the upper edge of the bottom transverse at the centre line to the second deck at side at the middle of the length, and are given in **Table 2.**

The depth of the transverse at the points of the brackets is not to be less than the tabular depth in any case.

(*b*) The transverses are to be increased 1 inch in depth for each increase of one complete foot in the sheer of the second deck.

(*c*) The face bars on the transverses are to extend between the inner edges of the bottom and deck transverses.

(*d*) Lightening holes not exceeding 6 inches diameter may be cut in the transverses as close to the shell bar as possible, and are to be fitted midway between the notches for the longitudinals.

(*e*) Notches cut in transverses for longitudinals are to be well rounded at the corners and are not to be rough punched.

2. **Bracket Attachments.**—(*a*) Side transverses are to be attached to the bottom transverses by brackets the length of the vertical arms of which, measured from the face of the transverses, is to be equal to 25 per cent of the depth "d." The arms of the brackets connecting the side and the second deck transverses are to be equal to 20 per cent of the depth "d."

(*b*) The thickness of the bottom bracket is to be the same as the bottom transverse, and the thickness of the top bracket the same as the deck transverse.

(*c*) The brackets are to be flanged 5 inches on the edge. Where the length of the bracket along the edge exceeds 66 inches, stiffening angles $3\frac{1}{2} \times 3$ inches of the same thickness as the bracket are to be fitted. Where the thickness of the bracket exceeds ·50 inch these angles are to be $3\frac{1}{2} \times 3\frac{1}{2}$ inches.

(*d*) The side transverses are to be attached to the bottom and deck transverses by double riveted overlaps, and the brackets are to be attached to the transverses by double riveted overlaps. Where the brackets extend to the shell the overlaps are to be treble riveted, except where the overlap comes in the way of a longitudinal, when it is to be quadruple riveted.

(*e*) The overlaps of the plates of the transverses are to be kept clear of the shell longitudinals as far as possible.

3. **Shell Attachment.**—(*a*) The angles attaching the transverse to the shell are to have the same thickness as the transverse.

(*b*) The riveted attachment of the side transverses and the shell are to be the same as required by **Section 2, clause 3** (*b*) for bottom transverses, except that the back bars need only be fitted in vessels exceeding 30 feet in depth.

4. **Stiffeners and Attachments to Longitudinals.**—(*a*) Two supporting brackets are to be fitted on longitudinals adjacent to the toes of the transverse brackets. Where the moulded depth of the vessel does not exceed 23 feet only one supporting bracket need be fitted.

(*b*) Each longitudinal is to be attached to the transverse by an angle which is to extend from the shell to the edge of the face bar and to half the depth of the transverse alternately. In way of the bottom brackets on the transverses all the angles are to extend to the edge of the bracket or face bar of the transverse. Where the transverses do not exceed 20 inches in depth all stiffening angles are to extend to face bar.

(*c*) At the upper half of the transverse the short and long stiffening angles are to have scantlings in proportion to the tabular depth of transverse as prescribed by **Table 3,** while at the lower half of the transverse all the stiffening angles are to be of the scantlings prescribed for long stiffening angles.

In vessels of 38 feet moulded depth and over, all the angles connecting the side longitudinals to the transverses are to be of the scantlings prescribed for long stiffening angles.

(*d*) The number and diameter of the rivets in the angle bars connecting the transverses to the longitudinals are to be in accordance with **Table 12.**

Where by the Table the broader flange of long stiffening angles exceeds 5 inches the number and diameter of the rivets are to be as required for 6 inch stiffening angles.

The diameter of the rivets in the short stiffening angles is to be the same as required for the rivets in the long stiffening angles.

(*e*) Where the flange of the face bar exceeds 7 inches in breadth, at least two horizontal supports are to be connected to the face bar.

5. **Side Transverses in 'Tween Decks.**—(*a*) The scantlings of the transverses in the 'tween decks are given in **Table 4.**

(*b*) Side transverses are to be attached to deck transverses by double riveted overlaps and in addition by double riveted brackets.

Brackets which extend to the shell and deck are to be attached to the transverses by treble riveted overlaps where the butt comes between the longitudinals, or by quadruple-riveted overlaps if the butt comes in way of a longitudinal.

(*c*) The brackets at the lower ends of the transverses are to be connected to the deck by a single angle, double riveted.

(*d*) The lengths of the arms of the brackets are to be one and a half times the depth of the side transverse, measured from the inner and lower edges of the side or deck transverses, as the case may be, and from the second deck. The brackets are to have the same thickness as the side transverses and are to be flanged 3 inches on the edge.

(*e*) The transverses are to be attached to the shell by single-riveted angles having the same thickness as the transverse.

(*f*) The attachments of the longitudinals to the transverses are to be as required for short stiffening angles by **Tables 3 and 12.** The thickness of these angles need not exceed the thickness of the transverse.

DECK TRANSVERSES.

Section 4. 1. **Scantlings.**—(*a*) The deck transverses fitted in conjunction with the side transverses are to have the scantlings given in **Tables 5, 6 and 7.**

(*b*) Lightening holes, not exceeding 4 inches diameter, may be cut in the transverses as close to the deck bar as possible, and are to be fitted midway between the notches for the longitudinals.

(*c*) Notches cut in transverses for longitudinals are to be well rounded at the corners and are not to be rough punched.

2. **Upper Deck Transverses in Expansion Trunk.**—(*a*) The web plates on the expansion trunk and centre line bulkhead are to be connected to the deck transverses by double riveted overlaps. Where the vertical webs extend to the deck the overlaps are to be treble riveted.

(*b*) The transverses are to be attached to the deck by a single riveted angle having the same thickness as the transverse.

(*c*) The angles attaching the deck longitudinals to the transverses are to extend to the bottom of the transverse and to a distance not less than six inches below the lower edge of the longitudinals alternately. Where the distance from the lower edge of the longitudinal to the bottom of the transverse is less than six inches, the angles are to extend to the bottom of the transverse.

These angles are to have scantlings of the dimensions and number of rivets required for short stiffening angles by **Tables 3** and **12**, but the thickness need not exceed the thickness of the transverse.

3. **Upper Deck Transverses in "Summer" Tank.**—(*a*) The face bar on the lower edge of the transverses is to extend from the side of the expansion trunk to the edge of the side transverse in the 'tween decks.

(*b*) The transverses are to be attached to the deck by a single riveted angle having the same thickness as the transverse.

(*c*) The angles attaching the deck longitudinals to the transverses are to extend to the upper edge of the face bar. These angles are to have flanges of the dimensions and number of rivets required for short stiffening angles by **Tables 3** and **12,** but the thickness need not exceed the thickness of the transverse.

4. **Second Deck Transverses.**—(*a*) The face bar on the upper edge of the transverse is to extend from the centre line bulkhead to the first deck longitudinal, and the face bar on the lower edge is to extend from the side transverse to the web on the centre line bulkhead.

(*b*) The transverse is to be attached to the deck by a single angle, double riveted, having the same thickness as the transverse.

(*c*) The angles attaching the deck longitudinals to the transverse are to extend to the upper edge of the face bar. These angles are to have flanges of the dimensions and number and diameter of rivets required for short stiffening angles by **Tables 3 and 12,** but the thickness need not exceed

the thickness of the transverse. Where the depth of the transverse is 24 inches or above the angles are to have the scantlings prescribed by the Table for long stiffening angles.

(*d*) Horizontal gusset plates, ·04 inch greater in thickness than the transverse, are to be fitted on the upper edge of the transverse on each side of the centre line bulkhead.

5. **Bracket Attachments.**—(*a*) The brackets attaching the upper deck transverses in the expansion trunk to the centre line bulkhead on the side opposite the web are to have the same thickness as the transverse. The depth of the brackets measured from the deck is to be twice the depth of the transverse. The horizontal arm of the brackets, measured from the bulkhead, is to be two-thirds the depth of the bracket, measured from the deck. The brackets are to be connected to the transverse by double-riveted overlaps, and are to be attached to the centre line bulkhead by double angles, single riveted, having the same thickness as the transverse.

(*b*) The brackets attaching the upper deck transverses in the summer tanks to the expansion trunk side are to have the same thickness as the transverses; the length of the arms of the brackets measured from the deck and from the side of the expansion trunk is to be twice the depth of the transverse. The brackets are to be double riveted to the transverses and are to be attached to the side of the expansion trunk by double angles, single riveted, having the same thickness as the transverse.

(*c*) The dimensions of the brackets attaching the second deck transverses to the webs on the centre line bulkhead are to be the same as the corresponding brackets at the ship's side. The brackets on the side of the centre line bulkhead opposite to the vertical web are to have the same dimensions, measured from the deck and bulkhead, as required for the brackets on the same side of the bulkhead as the vertical web.

The brackets are to be connected to the bulkhead by angles of the same scantlings and having the same number of rivets as are required for the corresponding bottom transverse bracket.

In all cases these attachment angles are to extend to the edge of the upper face bar on the deck transverse.

The brackets are to have the same thickness as the transverse and are to be flanged 5 inches on the edge. Where the length of the bracket along the edge exceeds 66 inches stiffening angles, $3\frac{1}{2} \times 3$ inches, of the same thickness as the bracket, are to be fitted. Where the thickness of the bracket exceeds ·50 inch these angles are to be $3\frac{1}{2} \times 3\frac{1}{2}$ inches.

(*d*) Brackets are to be connected to transverses by double riveted overlaps. Where the brackets extend to the upper edge of the transverse, the overlap is to be treble riveted.

BOTTOM LONGITUDINALS.

Section 5. 1. **Scantlings.**—(*a*) The scantlings of the bottom longitudinals are determined by the depth of the vessel, the first longitudinal numeral, and the spacing of the transverses, and are given in **Tables 8** and **9.**

(*b*) The longitudinals are to be spaced 30 inches apart.

(*c*) Where the length of the vessel exceeds 400 feet, additional back bars are to be fitted, attaching the bottom longitudinals to the shell plating on each side of the transverse bulkheads for a distance of about 40 per cent of the spacing of the transverses, measured from the bulkhead.

2. **Intercostal Girder.**—(*a*) Where the breadth of the vessel exceeds 60 feet, an intercostal girder of the same depth as the transverses is to be fitted, having a thickness ·04 inch less than the bottom transverse, and having double angles, $3\frac{1}{2} \times 3\frac{1}{2}$ inches, on its upper edge.

(*b*) The girder plate is to be stiffened by one vertical angle where the spacing of the transverses is not greater than 10 feet, and by two equally spaced angles where this spacing is exceeded.

3. **Attachment to Bulkheads.**—(*a*) The longitudinals are to be cut at the bulkheads, to which they are to be attached by brackets having the dimensions and number of rivets given in **Table 13.**

(*b*) The brackets are to be attached to the bulkhead by single angles having the same thickness as the bracket plate. Where the angles are extended on account of the omission of a horizontal stiffener on the bulkhead the requirements of **Section 11, clause 4** (*d*), are to be complied with.

(*c*) The intercostal girder is to be attached to the bulkhead by a single angle, double riveted, which is to extend 6 inches above the upper edge of the girder.

4. **Attachment to Transverses.**—(*a*) The longitudinals are to be attached to the transverses by angles as required by **Section 2, clause 4.**

(*b*) The intercostal girder is to be attached to the transverses by a single angle, double riveted, and a plate strap is to be fitted, connecting the face bars of the girder and the face bar of the transverse.

SIDE LONGITUDINALS.

Section 6. 1. **Scantlings.**—(*a*) The scantlings of the side longitudinals are determined by the spacing of the transverses, the first longitudinal numeral, and by the depth of the longitudinal below the upper deck. These are given in **Tables 10** and **11.**

(*b*) The longitudinals are to be spaced 30 inches apart below the second deck, but in 'tween decks of standard height only two longitudinals are required.

(*c*) The scantlings of the longitudinals at the bilge are to be graduated between those required for side longitudinals and bottom longitudinals.

2. **Attachments to Bulkheads.**—(*a*) The longitudinals are to be cut at the bulkheads to which they are to be attached by brackets having the dimensions and number of rivets given in **Table 13.**

The thickness of the brackets in the 'tween decks need not exceed ·40 inch.

(*b*) Where the brackets are not attached to the horizontal stiffeners on the bulkhead, they are to be connected to the bulkhead by single angles having the same thickness as the bracket plate.

3. **Attachments to Transverses.**—The longitudinals are to be attached to the transverses by angles as required by **Section 3, clauses** 4 and 5.

DECK LONGITUDINALS.

Section 7. 1. **Scantlings.**—(*a*) The scantlings of the longitudinals at the upper and second decks are given in **Tables 14** and **15.**

(*b*) The longitudinals are to be spaced 30 inches apart.

2. **Attachments to Bulkheads.**—(*a*) The longitudinals are to be cut at the bulkheads to which they are to be attached by brackets having the dimensions given in **Table 16.**

(*b*) The brackets are to be attached to the bulkhead by single angles, single riveted, having the same thickness as the bracket plates.

(*c*) The number and diameter of the rivets in each arm of the brackets are to be as given in **Table 16.**

3. **Attachments to Transverses.**—The longitudinals are to be attached to the transverses by angles, as required by **Section 4.**

BRACKET DETAILS.

Section 8. 1. **Flanging.**—(*a*) All hold brackets connecting the bottom and side longitudinals to the bulkheads are to be flanged.

(*b*) All other brackets which have 10 or more rivets in either arm are to be flanged.

(*c*) Bracket plates in cofferdams are to be flanged where the brackets to the adjacent longitudinals outside the cofferdams are flanged.

2. **Attachment Angles.**—(*a*) The angles attaching bracket plates to the bulkheads are to extend for at least 6 inches beyond the ends of the bracket arms.

(*b*) The bracket plates and angles are to be kept sufficiently clear of the bulkhead boundary bars to permit efficient caulking.

3. **General.**—Where transverse and centre line bulkheads intersect, a bracket is to be fitted in each corner of the intersection in way of each line of longitudinals.

SHELL PLATING.

Section 9. 1. **General.**—(*a*) The thickness of the shell plating in way of the longitudinal framing is given in **Table 17.**

(*b*) The number of end laps of the shell plating should be reduced as much as possible over the midship part of the vessel, and are, as far as practicable, to be kept well clear of the oil-tight bulkheads.

(*c*) Where transverse framing is adopted at the ends of the vessel the thickness of the plating is to be suitably increased.

(*d*) The edges of the plating are not to be joggled.

2. **Strengthening at ends of Poops and Bridges.**—(*a*) The thickness of the upper deck sheerstrake at the ends of the bridge, and at the front of the poop, is to be 20 per cent greater than the Rule midship thickness.

(*b*) The bridge side plating is to extend beyond the ends of the bridge, and is to be supported by web plates spaced not more than 5 feet from the ends of the bridge. The bulwark rail is to be connected to the bridge end bulkheads by substantial bracket plates, and similar bracket plates are to be fitted on the inner side of the bulkhead.

Similar arrangements are to be provided at the front of the poop.

DECKS.

Section 10. 1. **Deck Plating.**—(*a*) The thickness of the plating is given in **Tables 18** and **19.**

(*b*) The thicknesses of the upper deck plating given in the Tables assume one deck opening 4 feet in breadth on each side of the vessel. Where the breadth of the openings is greater or less than 4 feet, the thickness of the deck plating is to be adjusted in order to provide the same sectional area of material.

The midship thickness of the plating is to be carried to the poop, and is to be extended into the poop for a distance at least equal to one-third the breadth of the vessel.

(*c*) The number of end laps of the deck plating should be reduced as far as practicable over the midship part of the vessel.

2. **Stringer Plates.**—(*a*) Deck stringer plates of the dimensions given in **Tables 18** and **19** are to be fitted, and are to be attached to the shell plating by angles of the size given in **Tables 19** and **20.**

The midship thickness of the upper deck stringer plate is to be carried aft as prescribed for the deck plating.

(*b*) The thickness of the upper deck stringer plate at the ends of the bridge, and at the front of the poop, is to be 20 per cent greater than the Rule midship thickness.

3. **Continuity of Strength.**—(*a*) The second deck is to be fitted continuously and is to be carried through the cofferdams.

(*b*) The corners of deck openings are to be well rounded.

(*c*) The notching of upper deck stringer angles for scuppers should be avoided as far as practicable.

TRANSVERSE BULKHEADS.

Section 11. 1. **Plating.**—(*a*) The thickness of the plating is given in **Table 22.**

(*b*) The lowest strake is to be ·04 inch thicker than required by the Table. The lowest horizontal seam is to be kept above the attachment bars of the brackets to the bottom longitudinals.

2. **Vertical Webs below the Second Deck.**—(*a*) The scantlings of the webs are determined by the spacing, the length of the web and the height of the upper deck above the top of the web, and are given in **Table 24.**

The length of the web is to be taken from the second deck to the upper edge of the bottom longitudinal.

The spacing to be used in determining the scantlings is to be one-quarter the breadth of the vessel, where only one web is fitted.

The spacing to be used where two webs are fitted is one-half the distance between the adjacent web and the ship's side or centre line bulkhead. Where three webs are fitted on each side the spacing of the centre web is to be taken as half the distance between the adjacent webs, plus one foot.

(*b*) The face bar is to extend from the deck longitudinal or other bar to the bottom longitudinal.

(*c*) Lightening holes not exceeding 6 inches diameter may be cut in the webs as close to the bulkhead angle as possible, and are to be fitted midway between the notches for the horizontal stiffeners.

(*d*) Notches cut in the webs for the horizontal stiffener are to be well rounded at the corners and are not to be rough punched.

(*e*) The brackets at the top and bottom are to have a depth equal to 20 per cent of the length of the web.

The breadth of the brackets is to be not less than 30 inches, measured from the inner edge of the web, except at the shelf plate, where it is to extend to the inner edge of the shelf plate.

(*f*) The thickness of the top bracket is to be the same as, and the thickness of the lower bracket is to be ·04 inch greater than, the thickness of the web. The brackets are to be flanged 5 inches on the edge.

(*g*) The brackets are to be attached by double riveted overlaps to the web plate, and the web plate and brackets are to be attached to the longitudinals or girders at the deck and bottom by double riveted overlaps. Where the bracket forms part of the web, the butts of the plates are to be treble riveted.

The web plates and brackets are to be attached to the shelf plate by double angles, double riveted, which are to have the same thickness as the web plate.

(*h*) The webs are to be attached to the bulkhead by a single angle double riveted, which is to have the same thickness as the web. Where the moulded depth of the vessel does not exceed 23 feet this angle may be single riveted.

(*i*) A supporting bracket extending to the edge of the face bar is to be fitted to the web plate at about the middle of the span.

(*j*) The horizontal stiffeners are to be attached to the vertical web by stiffening angle bars, which are to extend from the bulkhead to the inner edge of the face bar on the web and to half the depth of the web alternately, but not less than six inches beyond the edge of the horizontal stiffeners. In way of the bracket at the bottom of the web all these angles are to extend to the inner edge of the face bar.

Where the depth of the vertical web does not exceed 20 inches all the stiffening angles are to extend to the inner edge of the face bar.

Above the supporting bracket the long and short stiffening angles are to have scantlings in proportion to the depth of the web, as prescribed by **Table 3** for side transverses, while below the supporting bracket all the stiffening angles are to have the scantlings prescribed for long stiffening angles.

(*k*) The number and diameter of the rivets in the angles connecting the horizontal stiffeners to the vertical web are to be in proportion to the depth of the horizontal stiffener, in accordance with **Table 12**, but the diameter of the rivets in the short stiffening angles is to be the same as required for the rivets in the long stiffening angles.

3. **Vertical Webs in Expansion Trunk.**—(*a*) The scantlings of the webs in the expansion trunks are given in **Table 25.**

(*b*) The lengths of the arms of the brackets at the top and bottom are to be the same as the breadth of the web plate, measured clear of the web or deck longitudinal.

(*c*) The brackets are to be double riveted in each arm.

(*d*) The webs are to be attached to the bulkhead by single angles, single riveted in 'tween decks of standard height.

(*e*) The horizontal stiffeners are to be attached to the web by stiffening angles extending the full depth of the web. These angles are to have flanges of the same dimensions and number of rivets as required for short stiffening angles, by **Tables 3** and **12**, but the thickness of these angles need not exceed the thickness of the web.

4. **Horizontal Stiffeners.**—(*a*) The horizontal stiffeners are to be spaced 30 inches apart.

The scantlings are to be determined by the span and by the depth below the upper deck at the middle line, and are given in **Table 26.** The span to be taken is that which gives the largest stiffener, whether the span is measured from the web to the ship's side, from the web to the centre line bulkhead, or from web to web.

(*b*) The horizontal stiffeners are to be connected to the side longitudinal and to the horizontal stiffeners on the centre line bulkhead by brackets.

The dimensions of the brackets and the number of rivets at the ship's side and centre line bulkhead are to be as required by **Section 6, clause 2.**

(*c*) The attachment of the horizontal stiffeners to the webs is to be in accordance with **clauses 2** and **3** above.

(*d*) The lowest horizontal stiffener is not to be more than 30 inches distant from the ends of the bracket plates connecting the bottom longitudinals to the bulkhead, and the distance between the stiffener and the ends of the bracket angles is not to exceed 12 inches.

5. **Shelf Plate.**—A horizontal shelf plate having the same thickness as the webs in the hold is to be fitted at the level of the second deck. The breadth of the shelf plate is to be $1\frac{3}{4}$ times the breadth of the vertical web below the second deck, but not less than 30 inches. The shelf plate is to be flanged 5 inches on the edge and is to be attached to the bulkhead by a single riveted angle. The attachment of the shelf plate to the centre line bulkhead and to the expansion trunk is to be double riveted.

6. **Bulkheads in Summer Tanks.**—(*a*) The horizontal stiffeners of the bulkheads in the Summer tanks are to be determined as for bulkheads in the expansion trunks from **Table 27.**

(*b*) Where vertical stiffeners are fitted, the scantlings are given in **Table 27.** The brackets attaching the lower ends of the vertical stiffeners to the second deck are to have the number of rivets given in the Table.

7. **Boundary Angles.**—(*a*) The bulkheads are to be attached to the shell plating, decks, expansion trunk, and centre line bulkhead by angles of the dimensions given in **Table 23.**

(*b*) The boundary angles are not to be joggled.

8. **Cofferdam Bulkheads.**—The cofferdam bulkheads are to be oil-tight and are to have the same thickness of plating, and the same connection to the shell plating and decks as required for the bulkheads of oil compartments.

The scantlings and spacing of the stiffeners are to be equivalent to those required for transverse oil-tight bulkheads.

CENTRE LINE BULKHEAD.

Section 12. 1. **General.**—(*a*) A centre line bulkhead is to be fitted throughout the oil compartments, pump room, and cofferdams, extending from the keel to the top of the expansion trunk. Beyond the cofferdams arrangements are to be made to avoid any abrupt termination of strength, by fitting webs and brackets.

(*b*) This bulkhead is to be oil-tight except in the pump rooms and cofferdams.

Where desired by the owners this requirement may be modified when a suitable notation will be made in the Register Book.

2. **Plating.**—(*a*) The thickness of the plating is given in **Table 22.**

(*b*) Where the moulded depth of the vessel exceeds 28 feet, the upper part of the bulkhead for a depth of 5 feet from the deck is to be increased by ·04 inch in thickness, and where the depth exceeds 42 feet by ·16 inch in thickness. For intermediate depths the increase in thickness is to be proportional.

The thickness of the strake next below is to be increased by half the amount specified above.

(*c*) The bottom strake is to be at least as broad as the lowest strake of the transverse bulkhead, and is to be ·04 inch thicker than required by the Tables.

3. **Vertical Webs below Second Deck.**—(*a*) The vertical webs on the bulkhead are to have the same scantlings and arrangements as the corresponding transverses at the ship's side, except that the thickness of the web plate may be ·06 inch less than the side transverse, with a minimum thickness of ·36 inch.

(*b*) The webs are to be attached to the bottom and deck transverses by brackets, which are to be flanged and are to have the same dimensions and scantlings as the brackets of the side transverses.

(*c*) The web plates are to be attached to the bulkhead by single angles, double riveted, which are to have the same thickness as the web.

(*d*) A supporting bracket extending to the edge of the face bar is to be fitted to the web plate at about the middle of the span.

(*e*) The horizontal stiffeners are to be attached to the vertical web by stiffening angles which are to extend from the bulkhead to the face bar of the web and to half the depth of the web alternately, but not less than 6 inches beyond the edge of the horizontal stiffeners. In way of the bracket to the bottom transverse all these angles are to extend to the edge of the bracket or face bar of the web.

Where the depth of the vertical web does not exceed 20 inches all the stiffening angles are to extend to the inner edge of the face bar.

Above the supporting bracket the short and long stiffening angles are to have scantlings in proportion to the depth of the web as prescribed by **Table 3** for side transverses, while below the supporting bracket these angles are to be of the scantlings prescribed for long stiffening angles.

(*f*) The number and diameter of the rivets in the angles connecting the horizontal stiffeners to the vertical web are to be in proportion to the depth of the horizontal stiffener in accordance with **Table 12**, but the diameter of the rivets in the short stiffening angles is to be the same as required for the long stiffening angles.

4. **Vertical Webs in Expansion Trunk.**—(*a*) The vertical webs in the expansion trunk are to have the scantlings given in **Table 28.**

(*b*) The web plate is to be connected to the second deck transverse by a double-riveted attachment and to the upper deck transverse as prescribed in **Section 4, clause 2.**

(*c*) The webs are to be attached to the bulkhead by single angles, single riveted.

(*d*) The horizontal stiffeners are to be attached to the web by stiffening angles extending to the edge of the web plate and 9 inches beyond the edge of the stiffener alternately. These angles are to have the same scantlings and number of rivets as required for the short stiffening angles of the vertical web below the second deck.

5. **Horizontal Stiffeners.**—(*a*) Horizontal stiffeners are to be fitted in line with the longitudinals at the ship's side and are to be spaced 30 inches apart, but only two longitudinals are required in 'tween decks of standard height.

(*b*) The scantlings are given in **Table 29** and are determined by the span and by the depth below the upper deck.

(*c*) The dimensions of the brackets and the number of rivets attaching the stiffeners to the transverse bulkheads are to be the same as required for the connection of the side longitudinals to the transverse bulkheads by **Section 6, clause 2.**

(*d*) The attachment of the horizontal stiffeners to the web plates is to be as required by **clauses 3** and **4** above.

6. **Boundary Angles.**—The bulkhead is to be attached to the keel plate by double angles, single riveted, of the dimensions given in **Table 21**, and to the upper deck by double angles of the size given in **Table 23.**

EXPANSION TRUNKS.

Section 13. 1. **Plating.**—(*a*) The expansion trunk sides are to be oil-tight throughout the oil compartments, and are to be carried through the cofferdams. They are to be arranged to form a continuation of the machinery casing at the after end, and are to be gradually tapered off at the forward end beyond the cofferdams.

(*b*) The thickness of the plating forming the sides of the expansion trunks is to be as given in **Table 19** for the plating of second decks.

(*c*) The plating is to be attached to the second deck by a double riveted angle of the size given in **Table 19** for second deck stringer angles, and to the upper deck by a single riveted angle of the size given in **Table 23** for attachment angles of bulkheads to upper deck.

2. **Vertical Webs.**—The scantlings and arrangement of the vertical webs are to be as required by **Section 12, clause 4,** for the vertical webs on the centre line bulkhead within the expansion trunk.

3. **Horizontal Stiffeners.**—The scantlings and arrangements of the horizontal stiffeners are to be as required by **Section 12, clause 5,** for the corresponding stiffeners on the centre line bulkhead within the expansion trunk.

INCREASED SPACING OF LONGITUDINALS.

Section 14. 1. **Increased Spacing.**—Where a spacing of longitudinals greater than 30 inches is desired, the scantlings generally are to be increased as specified in this Section.

2. **Longitudinals.**—The scantlings of the longitudinals at the shell and decks are to be increased to give equivalent strength to the requirements of the Tables.

3. **Shell Plating.**—The thickness of the bottom and side shell plating is to be increased ·02 inch for every 2 inch increase in spacing. The thickness of the sheerstrake and strake below need not be increased, but is to be at least equal to the increased thickness of side plating.

4. **Deck Plating.**—(*a*) The thickness of the upper deck plating is to be increased ·02 inch for every 4 inches increase in spacing.

(*b*) The thickness of the second deck plating is to be increased ·02 inch for every 4 inches increase in spacing.

5. **Bulkheads.**—The thickness of the bulkhead plating is to be increased ·02 inch for every 4 inches increase in the spacing of the stiffeners. The scantlings of the stiffeners are to be increased to give the equivalent strength to the requirements of the Tables.

6. **General.**—In cases in which increased spacing is adopted, such local increases in scantlings are to be made as may be considered necessary.

OIL FUEL FOR SHIP'S USE IN SUMMER TANKS.

Section 15. 1. **General.**—Where it is proposed to carry oil fuel in the summer tanks for the use of the ship the following additional requirements are to be complied with.

2. **Length of Tanks.**—The length of the tanks is not to exceed 60 feet.

3. **Wash Bulkheads.**—Wash bulkheads, which may have suitable lightening holes, are to be fitted not further apart than 30 feet.

HATCHWAYS.

Section 16. 1. **General.**—(*a*) Hatchways should not be larger or more numerous than is necessary to provide reasonable access to all compartments; as far as practicable they are not to be situated in the same transverse plane.

(*b*) The corners of all hatchways are to be well rounded.

(*c*) The hatchway covers are to be oil-tight.

(*d*) The requirements of **Section 22, clause 1** (*c*), are to be complied with.

2. **Coamings.**—(*a*) The coaming plates are to be ·40 inch thick, and the butts may be single riveted. The coaming may be attached to the deck plating by a single-riveted angle.

(*b*) Where the length or breadth of a hatchway exceeds 4 feet, and the height of the coaming is greater than 2 feet 6 inches, a vertical stiffener is to be fitted to the coaming, and the upper edge of the coaming is to be suitably stiffened.

3. **Covers.**—(*a*) Where the area of the hatchway does not exceed 10 square feet, the thickness of the cover is to be ·50 inch.

Where the area exceeds 10 square feet but is not greater than 25 square feet, the cover is to be ·60 inch in thickness, or may be ·50 inch if stiffened by 4 × 3 × ·40 inch angles spaced 2 feet apart.

If the area exceeds 25 square feet, the thickness of the covers is to be ·50 inch with stiffeners 5 × 3 × ·40 inch angles spaced 2 feet apart.

(*b*) The covers are to be secured by fastenings spaced not further apart than 15 inches along the sides and ends and not more than 9 inches from each corner.

4. **Hatchways to other than Oil Compartments.**—Exposed hatchways are to be constructed in accordance with the requirements of **Section 25** of the **Rules for the Building of Steel Vessels** and are to be closed watertight by efficient steel covers.

STRUCTURAL ARRANGEMENTS OUTSIDE OIL COMPARTMENTS.

Section 17. 1. **General.**—(*a*) The structure forward and abaft the oil tanks, pump rooms, cofferdams and oil fuel bunkers may be framed either on the longitudinal or transverse system, or combination thereof.

(*b*) Where the longitudinal system is adopted special strengthening is to be provided in the machinery space peaks, oil fuel and ballast tanks, bottom forward and in way of the panting arrangements.

(*c*) Where the transverse system is adopted, the arrangements are to embody such special strengthening as may be considered necessary.

2. **Continuity of Strength.**—Special care is to be taken to ensure continuity of strength at any junction of transverse and longitudinal framing.

RIVETING.

Section 18. 1. **Shell Plating.**—(*a*) The riveting of the end laps of the shell plating is to be as required by **Table 30.**

The seams are not to be less than double riveted.

In vessels above 450 feet, and not exceeding 475 feet in length, the rivets in the seams of side plating are to be spaced $3\frac{1}{2}$ diameters apart for three-quarters of the vessel's length amidships. Where the length exceeds 475 feet, but is not greater than 500 feet, three seams of side plating are to be treble riveted for three-quarters of the vessel's length amidships, with rivets spaced 4 diameters apart. In vessels from 500 to 525 feet in length, three seams, and in vessels from 525 to 550 feet in length four seams are to be treble riveted, with rivets spaced $3\frac{1}{2}$ diameters apart, for the distance specified above.

In vessels with two longitudinal bulkheads, the riveting of the seams of side shell plating may be as required by **Section 18, clause 10,** where the length of the vessel does not exceed 475 feet.

Where the length exceeds 475 feet, but is not greater than 500 feet, the rivets in three seams of side plating are to be spaced $3\frac{1}{2}$ diameters apart for three-quarters of the vessel's length amidships. In vessels from 500 to 525 feet in length, three seams are to be treble riveted for three-quarters of the vessel's length amidships, the rivets being spaced 4 diameters apart, and in vessels from 525 to 550 feet in length, three seams are to be treble riveted with rivets spaced $3\frac{1}{2}$ diameters apart.

2. **Decks.**—(*a*) The riveting of the end laps of the deck stringers and plating is to be as required by **Table 30.**

(*b*) The seams of the plating are to be double riveted.

(*c*) The flanges of the upper deck stringer angles, of the second deck stringer angle, and of the angles attaching the sides of the expansion trunk to the second deck, are to be double riveted.

(*d*) The rivets attaching the transverses to the deck are to be spaced 5 diameters apart.

(*e*) The rivets attaching the longitudinals to the deck are to be spaced 6 diameters apart.

3. **Bottom Transverses.**—The angles attaching the transverses to the shell are to have two or three complete rows of rivets as specified in **Section 2, clause 3.**

The spacing of the rivets is to be $4\frac{1}{2}$ diameters.

Where an additional back bar is required to be fitted by **Section 2, clause 3** (*b*), the spacing of the rivets may be 5 diameters.

Where the product of the length of the vessel in feet and the spacing of the transverses in feet does not exceed 3,000, the rivet spacing may be 5 diameters.

4. **Side Transverses.**—(*a*) The angles attaching the hold transverse to the shell are to have two or three complete rows of rivets as specified in **Section 3, clause 3.**

The spacing of the rivets is to be $4\frac{1}{2}$ diameters.

Where an additional back bar is required to be fitted by **Section 3, clause 3** (*b*), the spacing of the rivets may be 5 diameters.

Where the product of the length of the vessel in feet and the spacing of the transverses in feet does not exceed 3,000, the rivet spacing may be 5 diameters.

(*b*) The spacing of the rivets through the shell in the 'tween decks is to be as required in the holds.

5. **Bottom Longitudinals.**—(*a*) Where the product of the length of the vessel in feet and the spacing of the transverses in feet does not exceed 3,000, the rivets through the longitudinals and shell plating are to be spaced $4\frac{1}{2}$ diameters apart for a number of rivets on each side of the transverse or bulkhead equal to the spacing of the transverses in feet, and the spacing elsewhere may be 6 diameters.

Where the product exceeds 3,000, the spacing adjacent to the transverse and bulkheads for the number of rivets described above is to be $3\frac{1}{2}$ diameters; the spacing elsewhere may be 6 diameters.

(*b*) In the foremost oil compartment the spacing is to be $4\frac{1}{2}$ diameters throughout.

(*c*) The number of rivets attaching the longitudinals to the vertical stiffening angles on the transverses is to be as required by **Table 12.**

(*d*) The spacing of the rivets in the vertical flange of the shell angle of built longitudinals is to be the same as required through the longitudinals and the shell plating.

6. **Side Longitudinals.**—(*a*) Where the distance of the longitudinal below the upper deck does not exceed 15 feet, the rivets attaching the longitudinals to the shell are to be spaced 6 diameters apart.

Where the distance below the upper deck exceeds 15 feet, but is not greater than 25 feet, the rivets are to be spaced $4\frac{1}{2}$ diameters apart for a number of rivets on each side of the transverse or bulkhead equal to the spacing of the transverses in feet; the spacing elsewhere may be 6 diameters.

Where the distance of the longitudinal below the upper deck exceeds 25 feet, the spacing adjacent to the transverses and bulkheads for the number of rivets described above is to be $3\frac{1}{2}$ diameters; the spacing elsewhere may be 6 diameters.

(*b*) The number of rivets attaching the longitudinals to the horizontal stiffening angles on the transverses is to be as required by **Table 12.**

7. **Centre Line Bulkhead.**—(*a*) The end laps of the bulkhead plating are to be double riveted with the exception of the bottom strake, the end laps of which are to be treble riveted.

The seams are to be double riveted.

(*b*) Where the product of the length of the vessel, in feet, and the spacing of the transverses, in feet, does not exceed 3,000, the rivets attaching the vertical webs to the bulkhead are to be $\frac{3}{4}$ inch diameter, spaced 5 diameters apart Where this product exceeds 3,000, but does not exceed 4,000 the rivets are to be $\frac{3}{4}$ inch diameter, spaced $4\frac{1}{2}$ diameters apart. Where this product exceeds 4,000, the rivets are to be $\frac{7}{8}$ inch diameter, spaced $4\frac{1}{2}$ diameters apart.

(*c*) Where the distance of the horizontal stiffeners below the upper deck at side is not greater than 15 feet, the rivets attaching the stiffeners to the bulkhead are to be spaced 6 diameters apart.

Where the distance of the horizontal stiffeners below the upper deck at side exceeds 15 feet and is not greater than 25 feet, the rivets are to be spaced $4\frac{1}{2}$ diameters apart for a number of rivets on each side of the transverse or bulkhead equal to the spacing of the transverses in feet; the spacing elsewhere may be 6 diameters.

Where the stiffeners are at a greater distance below the upper deck at side than 25 feet, the rivets are to be spaced $3\frac{1}{2}$ diameters apart for a number of rivets on each side of the transverse or bulkhead equal to the spacing of the transverses in feet; the spacing elsewhere may be 6 diameters.

8. **Expansion Trunks.**—(*a*) The seams and end laps of the side plating are to be double riveted.

(*b*) The rivet attachment of the web plates to the trunk side plating is to be the same as required for the attachment of vertical webs to the centre line bulkhead.

(*c*) The rivets connecting the horizontal stiffeners to the trunk side plating are to be spaced 6 diameters apart.

9. **Transverse Bulkheads.**—(*a*) The end laps and seams of the bulkhead plating are to be double riveted.

(*b*) Where the depth of the vessel does not exceed 25 feet the rivets attaching the vertical webs to the bulkhead are to be $\frac{3}{4}$ inch in diameter, spaced $4\frac{1}{2}$ diameters apart. Where this depth is exceeded the rivets are to be $\frac{7}{8}$ inch, spaced $4\frac{1}{2}$ diameters.

(*c*) Where the distance of the horizontal stiffeners below the top of the expansion trunk at the middle line does not exceed 18 feet, the rivets attaching the horizontals to the bulkhead are to be spaced 6 diameters apart. For stiffeners at a greater distance below the top of the trunk the rivets are to be spaced 5 diameters apart.

10. **Spacing of Rivets.**—The rivets in the various parts of the structure are to be spaced as follows, centre to centre :—

$3\frac{1}{2}$ diam.	End laps of keel plates, shell plating and deck stringer plates except quadruple and quintuple end laps.	
	Seams of shell plating, seams and end laps of deck plating, plating of centre line and transverse bulkheads and expansion trunk sides.	Where thickness of plating does not exceed ·50 inch.
4 diam.	Quadruple riveted end laps of keel plates, shell plating and deck stringer plates.	
	Seams of shell plating, seams and end laps of deck plating, plating of centre line and transverse bulkheads and expansion trunk sides.	Where thickness of plating exceeds ·50 inch.
$4\frac{1}{2}$ diam.	Quintuple-riveted end laps of shell plating and deck stringer plates.	

5 diam.	Boundary angles of bulkheads, keel angles, deck stringer angles and angles at upper and lower corners of expansion trunks, bracket plate attachments of transverses and web plates, laps of transverses and webs.
6 diam.	Face bars on transverses and webs and built longitudinals.

11. **General.**—(*a*) Wherever the transverses, web plates, longitudinals and stiffeners cross seams and butts, there are to be, in general, the same number of rivets through these members as are required for the seams and end laps.

(*b*) In all cases where double riveted angles are required, two complete rows of rivets are to be fitted.

WORKMANSHIP.

Section 19. 1. **General.**—(*a*) The workmanship throughout is to be of the highest character and is to be submitted to the closest inspection.

(*b*) Notches cut in transverses and webs for longitudinals are to be well rounded at the corners and are not to be rough punched.

(*c*) Lightening holes in transverses and webs are to be limited in size and position as specified throughout the Rules.

2. **Riveting.**—(*a*) Particular attention is to be paid to the efficiency of the riveting, and the points of the rivets are to be left full. In all oil-tight surfaces such as shell plating decks, bulkheads, bulkhead boundary and connection angles, expansion trunks and stringer angles, the rivet holes are to be countersunk.

(*b*) Special care is to be taken in the punching and countersinking of the holes and the fitting together of the various parts. Where any unfairness exists in the holes they are to be rimered, not drifted, and larger rivets used in the rimered holes. The burr caused by punching and all drillings and rimerings are to be removed before the different parts are screwed together for riveting.

(*c*) Before the riveting of oil-tight surfaces is commenced the work is to be efficiently closed with nuts and screw bolts.

3. **Caulking.**—(*a*) Caulking is to be carefully and thoroughly executed.

(*b*) All oil-tight joints are to have the surfaces of the steel plates fitted close to each other and to be caulked, as far as practicable, without the use of packing.

(*c*) Where the boundary bars of oil-tight bulkheads consist of double angles, both flanges of each bar are to be caulked.

4. **Angles.**—In oil-tight work shoe pieces are to be fitted at all corners.

TESTING OF COMPARTMENTS.

Section 20. 1. **General.**—Each oil compartment is to be filled separately with water and tested by pressure either before the vessel is launched or in dry dock.

2. **Test Head.**—The test pressure is to be obtained by means of a head of water eight feet above the highest point of the expansion trunk or the deck in the case of summer tanks.

3. **Cofferdams.**—Cofferdams are to be tested by being filled with water to the top of the hatchway.

4. **Special Surveys.**—At all Special Surveys each oil compartment and cofferdam is to be tested by being filled with water to the top of the hatchway in the expansion trunk and cofferdam.

PUMPING ARRANGEMENTS.

Section 21. 1. **Oil Pumps.**—(*a*) A complete system of piping and pumps is to be fitted for dealing with the oil cargo.

(*b*) Oil pump rooms are to be enclosed by oil-tight bulkheads and are to have no direct communications with the machinery space.

(*c*) Oil pumps fitted for the purpose of filling or emptying the oil compartments are to be kept entirely separate from the pumps fitted for filling or clearing the water ballast compartments of water.

(*d*) Steam-driven cargo oil pumps are to be capable of being controlled from outside the cargo pump room.

2. **Water Ballast.**—(*a*) The water ballast pipes are not to pass through the oil compartments nor the pipes for the oil through any water ballast space.

(*b*) A separate ballast pump is to be fitted forward of the oil compartments for the purpose of filling and emptying the forward ballast tanks.

3. **Motive Power of Cargo Oil Pumps.**—Where the cargo oil pumps are not driven by steam, plans of the arrangements for driving the pumps are to be submitted for consideration.

4. **General.**—(*a*) Efficient arrangements are to be provided for draining the 'tween deck spaces.

(*b*) Sounding pipes are to be fitted in the cofferdams.

(*c*) Pipes connected to the oil fuel bunkers and oil fuel storage tanks are to be entirely separate from pipes which may be used for dealing with the cargo oil.

(*d*) Steaming-out and fire-extinguishing connections for cargo oil tanks or cargo oil pipe lines are to be fitted with

valves of non-return type, and the main supply pipe to these connections is to be fitted with a master valve placed in a readily accessible position.

(*e*) Where the exhaust from heating coils in the cargo oil tanks is led to an observation tank, this tank is to be situated in a well ventilated part of the engine room or other compartment outside the boiler room.

(*f*) In the cargo pump rooms, drain pipes from steam or exhaust pipes or from the steam cylinders of pumps are to terminate well above the level of the bilges.

VENTILATION.

Section 22. 1. **Oil Compartments.**—(*a*) Efficient means are to be provided for clearing dangerous gases from the tanks and cofferdams.

(*b*) Suitable arrangements are to be provided to prevent the accumulation of gas in pockets.

(*c*) A screw plug not less than 6 inches diameter or a 6 inch diameter sidelight is to be fitted to each hatchway cover and a gas cock is to be fitted on the coaming.

2. **Other Compartments.**—Efficient means of ventilation are to be provided for pump rooms, cofferdams, deck houses, and other enclosed spaces.

ELECTRIC LIGHTING.

Section 23. General.—The special requirements contained in **Section 15** of the **Rules for Electrical Equipment** are to be complied with.

71, Fenchurch Street, London, E.C.3.
15th February, 1945.

PERIODICAL SPECIAL SURVEYS.

Section 24. 1. **Preparation of Tanks.**—(*a*) At all special surveys the tanks are to be cleaned out and thoroughly cleared of gas. Every precaution is to be taken to ensure safety during inspection.

(*b*) The strums of the cargo suction pipes are to be removed to facilitate examination of the shell plating and bulkheads in that vicinity.

2. **Testing.**—(*a*) Each oil compartment and cofferdam is to be tested by being filled with water to the top of the hatchway in the expansion trunk or cofferdam.

(*b*) The tanks may be filled to the light load line when the vessel is in dry dock, and the remainder of the testing carried out afloat. The centre line bulkhead need not be tested independently.

(*c*) Where extensive repairs have been effected to the shell plating, the tanks should be tested by being filled when the vessel is in dry dock. If that is not practicable, particulars of the method proposed to be adopted in testing the tanks are to be submitted for approval.

(*d*) Where desired by the Owner, a system of examination and testing of the oil compartments may be adopted such that all the compartments are examined and tested every four years, and that the period which elapses between consecutive examinations and testing of each compartment shall not exceed four years.

In such cases the certificate of classification will be endorsed "Progressive Survey of Oil Tanks" and this notation will also be printed in the Register Book.

The date of survey recorded in the Register Book will be the date on which the principal part of the requirements for Periodical Special Surveys is complied with.

ELECTRIC ARC WELDING

IN

SHIP CONSTRUCTION.

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RULES FOR ELECTRIC ARC WELDING IN SHIP CONSTRUCTION.

GENERAL.

Section 1. 1. The use of Electric Arc Welding in the structure of ships intended to be classed with the Society is subject to compliance with the following requirements, and to :—

(*a*) Plans being submitted showing particulars and scantlings of the welding arrangements proposed; where welding is to be extensively adopted for the main structure, the assembly and welding sequences are also to be submitted.

(*b*) The electrodes used complying with the tests and requirements set forth in Sections 4 and 5.

(*c*) The workmanship being to the satisfaction of the Society's Surveyors.

2. Particulars indicating the principal parts which are welded will be given in the Register Book as deemed desirable by the Committee.

3. Special attention is to be paid to structural continuity. Abrupt changes of shape or section are to be avoided; corners of all openings should be well rounded.

4. The thickness of plating may in certain cases require to be increased to take account of the greater area of panels resulting from the omission of faying flanges in the supporting structure.

5. The structural arrangements are to be such as will ensure easy access for welding operations, and that downhand welding can be employed where practicable.

6. The intersection of welded connections should be avoided where possible. Where stiffening members cross butts or seams of plating the webs of the stiffening members should be scalloped. The webs of stiffening members and bilge keels should also be scalloped at their butts.

7. The type and disposition of connections and their sequences of welding are to be so arranged that stresses resulting from welding operations are reduced to the minimum.

8. Where the structure embodies both welding and riveting, welded joints are in general to be completed before riveting in their vicinity. Individual connections which are proposed to be part welded and part riveted shall not be adopted unless specifically approved.

9. Alternative proposals or methods of welding considered by the Committee to be equivalent to those set forth in the Rules will be accepted.

WORKMANSHIP.

Section 2. 1. Welding operators are to be proficient in the type of work on which they are engaged. Trained supervisors are to be provided to ensure effective control at all stages during assembly and welding. The welding plant and appliances are to be suitable for the purpose intended and are to be maintained in an efficient condition.

2. Procedures for the welding of all joints are to be established for the types of electrode, edge preparation and welding position proposed to be adopted. For this purpose, the Surveyors may require sample tests to be prepared under similar conditions to those which will obtain during construction.

The diameter of electrode, current, voltage, rate of deposit and number of runs are to conform, as far as practicable, to those established in accordance with the preceding paragraph. Provision is to be made for checking the current in the vicinity of the arc.

3. The preparation of plate edges is to be accurate and uniform.

All joints are to be properly aligned and closed or adjusted before welding.

Where excessive gaps exist between surfaces or edges to be joined, the corrective measures adopted are to be to the satisfaction of the Surveyors.

Excessive force is not to be used in fairing and closing the work, and rigid restraint during welding operations is to be avoided.

4. The surfaces of all parts to be welded are to be clean, dry, and free from rust, scale and grease.

5. All welds are to be sound, uniform and substantially free from slag inclusions and porosity. Care is to be taken to ensure thorough penetration and fusion, and the avoidance of undercut.

The surfaces and boundaries of each run of deposit are to be thoroughly cleaned and freed from slag. Defective sections of welds are to be cut out and rewelded.

6. Before a sealing run is applied to a butt weld, the clean metal of the original root run is to be exposed.

7. Adequate protection is to be provided where work is required to be carried out in exposed positions during wet, windy or severely cold weather.

WELDED CONNECTIONS.

Section 3. 1. **Butt Welds.**—Butt welds should be adopted in preference to overlaps in shell and strength deck plating and other important structural connections. In general the edges to be joined by manual welding are to be bevelled on one side of the plating or on both sides to provide an included angle of about 60 degrees. Where the plates are bevelled on one side only a sealing weld is to be applied to the reverse side of the butt.

Where it is desired to adopt other forms of edge preparation full details are to be submitted.

2. **Fillet Welds.**—(*a*) The dimensions of fillet welds for various structural connections are to be as required by **Tables 1, 2, 3, 4 and 5.**

(*b*) The size of fillet weld given in **Table 1** is the minimum length of leg of the fillet. The throat thickness of the weld is to be 70 per cent. of the leg length.

3. **Tee Connections.**—(*a*) The leg length of the fillets is to be governed by the thickness of the abutting plate or web. Where the difference between the thicknesses of the parts to be joined is considerable, the size of the fillet will be specially considered.

(*b*) All connections in **Tables 2** and **4** are to have double continuous fillet welds. Intermittent welding may be adopted for the connections in **Tables 3** and **5.**

4. **Intermittent Fillets.**—(*a*) The length of intermittent welds is to be measured over the correctly proportioned fillet, clear of end craters.

(*b*) Where short intermittent fillets are adopted, they are to have a minimum length of 3 inches. Their size is to be as required for **Type 1, Table 1,** with a distance centre to centre not exceeding that indicated in Tables 3 and 5.

(*c*) Where long intermittent fillets are adopted, they are to have a maximum length of about 12 inches, and are to be disposed on alternate sides of the web. They are to be of the size required by **Type 2, Table 1.** Where staggered intermittent fillets are required by Tables 3 and 5, the long intermittent fillets are to have a distance centre to centre equal to their length. Where chain intermittent fillets are required by **Tables 3** and **5,** the long intermittent fillets are to overlap so that the distance centre to centre is equal to two-thirds of their length.

(*d*) As an alternative to staggered intermittent welding, double continuous fillets of the size required for **Type 3, Table 1,** may be adopted. Where chain welding is required, the size of the continuous fillets is to be as required for **Type 2, Table 1.**

(*e*) Intermittent fillets are to be doubled at, and carried round the ends of brackets, of hold frames, longitudinals, beams, bulkhead and floor stiffeners, and of floors to shell, inner bottom and centre girder.

5. **Overlaps.**—Where overlapped joints of plating are adopted, the breadth of the overlap is to be four times the thickness of the thinner of the plates so joined, but need not exceed 2 inches. Particulars of the welding are to be submitted.

6. **Additional Attachment.**—Welded connections may be required to be increased to meet particular local stresses, and also where the spacing or span of stiffening members is increased above Rule.

REGULATIONS AND TESTS FOR THE APPROVAL OF ELECTRODES.

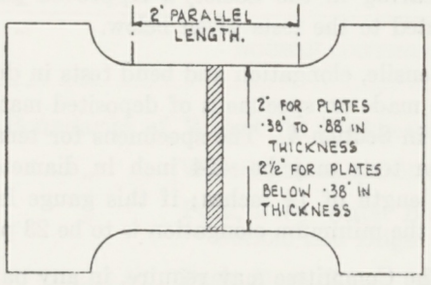
Section 4. 1. The manufacturers' plant and method of production of the electrodes are to be such as to ensure reasonable uniformity in manufacture.

2. Electrodes will be approved by the Committee subject to compliance with the following tests.

The test pieces are to be prepared in the presence of the Society's Surveyor and all tests carried out under his supervision. The steel used in the preparation of the test pieces is to comply with the requirements of Section 4 of the **Rules for Quality and Testing of Materials.**

3. All test specimens are to be prepared and tested in duplicate. If one specimen fails to satisfy the test, two further specimens may be prepared, both of which must prove satisfactory.

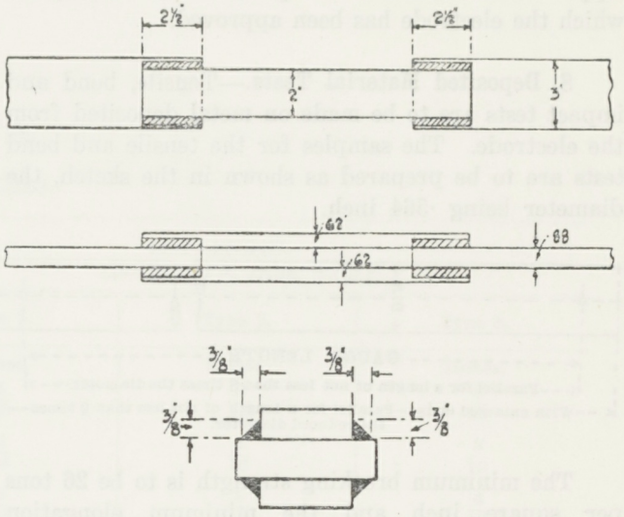
4. **Butt Welds.** (*a*) **Tensile Tests.**—Tensile test specimens of the form shown in the sketch are to be prepared. One of the specimens is to be of the maximum thickness which would normally be welded with square edges, and others, which are to be welded with V butts, are to be ·38, ·62 and ·88 inch in thickness. The surfaces of the welded joints are to be rendered flush on both sides.



The mean tensile strength of the test specimens for each thickness is to be not less than 26 tons per square inch.

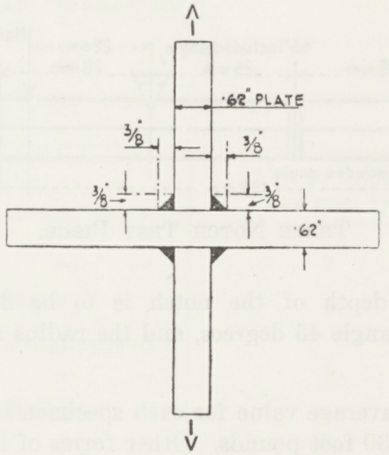
(*b*) **Bend Tests.**—Bend tests are to be made on specimens similar to those shown above from material ·38 and ·88 inch in thickness. These are to withstand bending without fracture through an angle of 90 degrees over a bar of diameter equal to four times the thickness of the test piece. The rough edges of the samples may be removed by filing or grinding, and the test is to be made so that the wide part of the vee is in tension.

5. **Shear Tests.**—Shear tests are to be carried out on specimens prepared as shown on the sketch.



The shear strength of the welds is to be not less than 17 tons per square inch, calculated on the throat thickness.

6. **Fillet Weld Tests.**—Fillet weld tests are to be made on samples 2 inches in width as shown in the sketch.

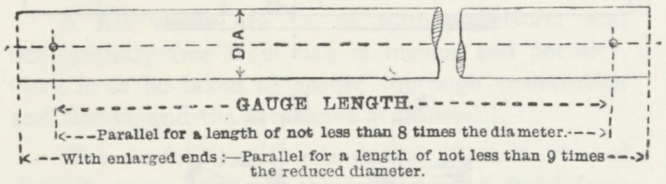


They are to withstand a tensile load, applied in the direction shown, of 73 × t tons, t being the throat thickness of the welds.

7. **Vertical and Overhead Tests.**—Where it is desired by the Manufacturers to demonstrate that an electrode is suitable for vertical or overhead welding, tensile and bend tests are to be made from plates ·38 inch in thickness, together with fillet weld tests, all as set forth above, for each position for which approval is sought.

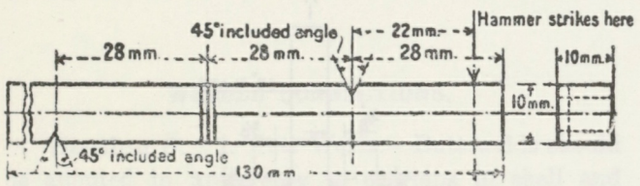
An indication will be given in the List of Approved Electrodes of the positions of welding for which the electrode has been approved.

8. Deposited Material Tests.—Tensile, bend and impact tests are to be made on metal deposited from the electrode. The samples for the tensile and bend tests are to be prepared as shown in the sketch, the diameter being ·564 inch.



The minimum breaking strength is to be 26 tons per square inch and the minimum elongation 18 per cent. The samples are to withstand bending to 120 degrees without fracture over a bar having a diameter twice the diameter of the test piece.

The impact tests are to be made on a standard form of Izod test piece as shown in the sketch.



Three Notch Test Piece.

The depth of the notch is to be 2 mm. the included angle 45 degrees, and the radius at the root ·25 mm.

The average value for each specimen is to be not less than 30 foot pounds. Other forms of impact test may be adopted with suitably modified values.

9. Chemical Analysis.—Chemical analyses of the metal of each type of electrode and of the deposited material of a weld made by the same electrode are to be supplied.

10. The Committee is to be notified of any alteration proposed to be made in the process of manufacture subsequent to approval.

11. Each carton or package of approved electrodes is to contain a certificate from the manufacturer on the following lines:—

"The ——— Company certifies that the composition and quality of these electrodes conform with those of the electrodes used in making the test pieces submitted to and approved by the Committee of Lloyd's Register of Shipping."

PERIODICAL INSPECTION OF MAKERS' WORKS.

Section 5. 1. All establishments where approved electrodes are manufactured shall be subject to periodical inspection by the Society's Surveyors. These visits will take place as may be considered necessary by the Committee but at least once a year. On these occasions samples, selected by the Surveyors, of each of the electrodes manufactured by the Makers and appearing in the Society's Approved List, will be subjected to the tests given below.

2. Tensile, elongation and bend tests in duplicate are to be made on specimens of deposited material as set forth in Section 4. The specimens for tensile and elongation tests may be ·424 inch in diameter with a gauge length of 1½ inches; if this gauge length is adopted, the minimum elongation is to be 23 per cent.

3. The Committee may require, in any particular case, such additional tests as may be considered necessary.

71, Fenchurch Street, London, E.C.3.
15th February, 1945.

TABLE 1.

FILLET WELDS.

PLATING THICKNESS. (*See* Section 3, clause 3 (*a*).)	LEG LENGTH. (*See* Section 3, clause 2 (*b*).)		
	Type 1.	Type 2.	Type 3.
Inches.	Inches.	Inches.	Inches.
Not exceeding ·30	$\frac{4}{16}$	$\frac{3}{16}$	$\frac{3}{16}$
Above ·30 and not exceeding ·44 ...	$\frac{5}{16}$	$\frac{4}{16}$	$\frac{3}{16}$
Above ·44 and not exceeding ·60 ...	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{4}{16}$

CARGO AND PASSENGER SHIPS.

TABLE 2.

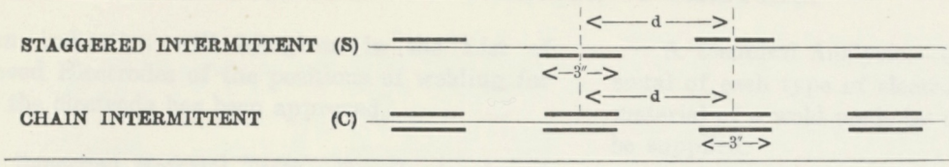
TEE JOINTS.

DOUBLE CONTINUOUS FILLET WELDS.	TYPE OF WELDS. (*See* Table 1.)
Boundaries of Watertight Bulkheads, Tunnels and Flats	2
„ Watertight and Oiltight Floors in Double Bottoms ...	1
„ Peak, Deep Water Ballast and Oil Fuel Tank Bulkheads at Bottom and Bilge	1
„ Peak, Deep Water Ballast and Oil Fuel Tank Bulkheads at Sides and Deck	2
Side Frame Brackets to Margin Plate	2
„ „ „ „ „ in Panting Area	1
Floors in Double Bottom to Margin Plate	2
„ „ „ „ „ in Panting Area	1
Centre Girder to Keel and Inner Bottom if Watertight	2
Vertical Margin Plate to Shell	2
Deck Girder Brackets to Bulkheads	2
Floors in Single Bottom to Continuous Centre Keelson	1

TABLE 3.

SPACING OF INTERMITTENT FILLET WELDS. ALL WELDS OF TYPE 1, TABLE 1.

For alternative arrangements see Section 3, clause 4 (*c*) *and* (*d*).



	S or C	Distance (d) Centre to Centre.
		Inches.
Side Framing.		
Side Frames to Shell, spacing not exceeding 30 inches	S	7
" " " spacing exceeding 30 inches	S	6
" " " in Peaks, Deep Water Ballast and Oil Fuel Tanks	S	5½
" " " in Panting Area	S	5½
Double Bottoms.		
Centre Girder to Keel	C	5
" " Inner Bottom in Engine Space and under Thrust Seating	C	6
" " " " elsewhere	C	7
Floors to Shell, spacing not exceeding 33 inches	S	7
" " spacing exceeding 33 inches	S	6
" " forward of ¼L amidships	C	5½
Floors to Inner Bottom under Engines and Thrust Seating	C	6
" " " elsewhere	S	7
Floors to Centre Girder in Engine Space, Thrust Recess, and at Boiler Bearers	C	5
" " " elsewhere	S	5
Intercostals to Shell	S	6
" Inner Bottom under Engines and Thrust Seating	C	6
" " " elsewhere	S	7
" Floors	S	7
Bracket Floors to Frames and Reverse Frames	S	5
Single Bottoms.		
Floors to Shell	S	7
" " in Peaks	S	5
" " forward of ¼L amidships	C	5½
Centre Keelson to Keel	C	5
Side Keelson to Shell	S	6
Keelsons to Top Member in Engine Room	C	5½
" " " elsewhere	S	6
Bulkheads.		
Stiffeners to Watertight Bulkheads	S	7
" Non-Watertight Bulkheads	S	8
Stiffener Brackets	S	5
Deep Water Ballast and Oil Fuel Tanks.		
Horizontal Girders to Shell or Bulkheads	S	4½
" " " " in way of Brackets	C	4½
" " to Face Plates	S	6
Girder Brackets, where overlapped	C	4½
Vertical Stiffeners	S	6
Stiffener Brackets	S	5
Beams.		
Where on every Frame	S	7
" " " " at Watertight and Oiltight Flats	S	6
" " alternate Frames	S	6
Beam Knees	S	4
Deck Girders.		
Webs to Deck	S	5
" Face Plates	S	7
Web Frames.		
Webs to Shell	S	5
" Face Plates	S	7
Brackets to Webs, where overlapped	C	4½
Hatchways.		
Webs of Hatch Beams to Face Plates	S	7

SHIPS CARRYING PETROLEUM IN BULK.

TABLE 4.

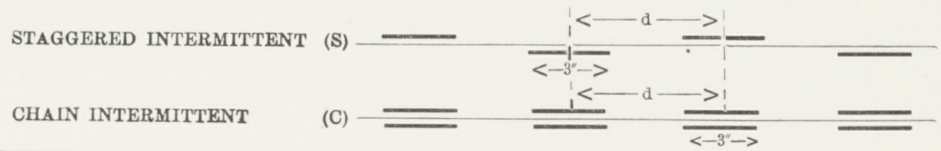
TEE JOINTS.

DOUBLE CONTINUOUS FILLET WELDS.	TYPE OF WELDS. (*See* Table 1.)
Bottom Transverses or Deep Longitudinal Girders to Shell	2
" " " " " " in way of End Brackets	1
Brackets on Bottom Transverses or Girders to Bulkheads	1
Side Transverses to Shell	2
Boundaries of Longitudinal Bulkheads to Bottom and Deck	1
" Transverse Bulkheads to Shell at Bottom and Bilge ...	1
" " " " Sides and to Deck and Longitudinal Bulkheads	2

TABLE 5.

SPACING OF INTERMITTENT FILLET WELDS. ALL WELDS OF TYPE 1—TABLE 1.

For alternative arrangements see Section 3, clause 4 (*c*) and (*d*).

STAGGERED INTERMITTENT (S) / CHAIN INTERMITTENT (C) 	S or C	Distance (d) Centre to Centre.
		Inches.
Bottom Longitudinal or Transverse Frames to Shell	S	5
Side " " " "	S	6
Horizontal Girders to Shell or Bulkheads	S	4½
" " " " in way of Brackets	C	4½
" " Face Plates	S	6
Girder Brackets, where overlapped	C	4½
Deck Transverses or Longitudinal Girders to Deck	S	4½
" " " " Side Frames or Bulkheads	S	5
Deck Longitudinals or Beams	S	6
Bulkhead Stiffeners	S	6

ENGINES AND BOILERS

OF

STEAM VESSELS

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RULES FOR THE CONSTRUCTION AND SURVEY OF ENGINES AND BOILERS OF STEAM VESSELS.

Section 1. In vessels propelled by steam engines, the materials used in the construction of the machinery and boilers are to comply with the **Rules for the Quality and Testing of Materials.** The machinery and boilers are to be inspected throughout, the boilers tested by hydraulic pressure, and the machinery tested under steam by the Society's Engineer-Surveyors, who will furnish a report to the Committee. If found satisfactory the Committee will thereupon grant a certificate, and insert in the Register Book the notation, "LMC" *in red* (*i.e.* "LLOYD'S MACHINERY CERTIFICATE"), indicating that the machinery and boilers are certified to be in good order and safe working condition.

Section 2. 1. In steam vessels built under Special Survey, the main and auxiliary engines and boilers (including press boilers and similar apparatus for floating whale-oil factories), steering engines, all pumps, evaporators and feed water heaters and pressure filters intended for essential services and domestic boilers intended for working pressures exceeding 50 lb. per square inch or having heating surfaces greater than 50 square feet are also to be constructed under Special Survey.

2. In cases of machinery or new boilers being built under Special Survey, the distinguishing mark ✠ will be noted in the Register Book in red, thus: "✠LMC," or "✠NE&B," or "✠NB."

3. In order to facilitate the inspection, plans in triplicate of the following items are to be submitted for consideration before the work is commenced :—

(*a*) Boilers.
(*b*) Superheaters.
(*c*) Arrangement and drainage of steam pipes.
(*d*) Crankshaft.
(*e*) Reduction gear.
(*f*) Screwshaft.
(*g*) Oil fuel pumping arrangements and oil fuel tanks not forming part of the structure of the vessel. (*See* the **Rules for Steel Ships, Section 20D.**)
(*h*) Bilge and ballast pumping arrangements. (*See* the **Rules for Steel Ships, Section 34.**)

Where superheating is employed, diagrammatic plans of the arrangements proposed for feed water heating and filtering are also to be submitted for consideration.

4. Where it is proposed to depart from the requirements of these Rules, the Committee will be prepared to give consideration to the circumstances of any special case.

5. Any novelty in the construction of the machinery or boilers is to be reported to the Committee.

6. The Surveyors are to examine the materials and workmanship from the commencement of the work until the final test of the machinery under steam; any defects, &c., to be pointed out as early as possible.

7. The Surveyors may also, if desired, compare the work as it progresses with the requirements of the specification agreed upon by the parties concerned, and certify to the conditions thereof, as far as can be seen, being satisfactorily complied with.

8. The cylinders of steam reciprocating engines are to be tested by hydraulic pressure as follows :—

COMPOUND EXPANSION ENGINES :

H.P. Cylinder	W.P. × 1·5
L.P. Cylinder	30 lb. per square inch.

TRIPLE EXPANSION ENGINES :

H.P. Cylinder	W.P. × 1·5
I.P. Cylinder	W.P. × ·5
L.P. Cylinder	30 lb. per square inch.

QUADRUPLE EXPANSION ENGINES :

H.P. Cylinder	W.P. × 1·5
First I.P. Cylinder ...	W.P. × ·6
Second I.P. Cylinder ...	W.P. × ·4
L.P. Cylinders	30 lb. per square inch.

Where W.P. is the boiler working pressure in lb. per square inch.

Steam Turbines.—The nozzle boxes of impulse steam turbines are to be tested by hydraulic pressure to 1·5 times the boiler working pressure.

The steam casings of all turbines are to be tested by hydraulic pressure to 1·5 times the working pressure in the casing or to 30 lb. per square inch, whichever is the greater.

9. The machinery and boilers are to be securely fixed to the vessel to the satisfaction of the Surveyor.

Section 3. 1. **Feed pumps.**—All steam vessels are to be provided with at least two entirely separate means of supplying the main boilers with feed water, when working at full power.

2. If the main feed supply is from pumps worked from the main engines, then with engines above 70MN, there are to be two main feed pumps, so arranged that either can be shut off and overhauled while the other is at work. Each pump is to be capable of performing the whole work required.

3. In engines of 70MN and under, and also in all engines of steam tugs and tenders, one main feed pump worked from the main engines will be approved, provided the auxiliary feed pump required by **clause 5** is fitted.

4. The main feed pumps may be worked by independent engines provided they are fitted with automatic regulators for controlling their speed. If only one such pump is fitted for the main feed the auxiliary feed pump required by **clause 5** is also to be fitted with an automatic speed regulator.

5. (*a*) An independent power pump is to be provided as an auxiliary feed supply, capable of performing the whole work required of feeding the boilers at full power, and is to be fitted with suctions to the hotwell and to the sea.

Where, however, the boilers are of the water tube type and an evaporator and adequate storage capacity for fresh water are provided, the suction to the sea may be omitted.

(*b*) This pump may also be used for general purposes provided it be not connected to compartments containing oil fuel, cargo oil or oily water, and the suction pipes to the bilges be entirely distinct from those to the hotwell, tanks or sea.

The suction valves to the hotwell or feed water drain tanks are to be of non-return type.

6. (*a*) Where superheated steam is used in main or auxiliary engines of reciprocating type, filters are to be fitted to provide for the continuous filtration of the boiler feed water.

(*b*) Where a direct contact heater is supplied with exhaust steam from engines of reciprocating type, the feed water from the heater is to be led through the filters required by **paragraph** (*a*) or through additional filters, arranged to provide for continuous filtration.

In lieu of the additional filters, an efficient oil separator may be fitted in the steam supply to the heater.

Section 4. Bilge and General Service Pumps.—1. The main engines are to be fitted with two bilge pumps so arranged that one can be overhauled whilst the other is at work.

2. In engines of 70 MN and under and also in engines of steam tugs and tenders, one bilge pump worked from the main engines will be sufficient, provided the independent power pump required by **clause 4** is fitted.

3. In lieu of bilge pumps worked from the main engines, an independent power pump may be fitted additional to that required by **clause 4.**

4. An independent power pump is to be provided connected to the main bilge system as required in **clause 5.**

5. (*a*) Each power bilge pump is to be arranged to draw water from any hold or machinery compartment of the vessel, except where manual pumps only are permissible.

(*b*) Each power bilge pump required by the preceding clauses is to be capable of giving a speed of water through the pipes of the largest diameter required by the formula in **Section 34, clause 9,** of the **Rules for Steel Vessels,** of not less than 400 feet per minute, under ordinary working conditions.

Where, however, two bilge pumps are worked from the main engines, the capacity of each main engine bilge pump may be half that required above.

Alternatively, the capacity of the main engine bilge pumps may be less than that required above, provided the deficiency be made good by the independent power pump connected to the main bilge line.

(*c*) All power pumps which are essential for bilge service are to be of self-priming type.

(*d*) At least one of the independent power pumps (**clauses 3, 4**) is to be fitted with a direct suction to the machinery space (or to each engine room and boiler room where these compartments are separated by watertight bulkheads), which can be used while the other bilge pumps are being used on other parts of the vessel. (*See* **Section 34, clause 3, paragraph** (*c*)**, Rules for Steel Vessels.**)

This suction is to be led direct to the suction valve chest of the pump.

(*e*) In lieu of the bilge pump direct suction to the engine room, referred to in the previous paragraph, a steam ejector suction of the same bore may be fitted. A steam ejector will not, however, be accepted as equivalent to the independent power pump required to be connected to the main bilge line.

(*f*) The bilge suctions in machinery spaces are to be led from easily accessible mud-boxes placed above the level of the working floor, with straight tail pipes to the bilges, and having covers secured in such a manner as to permit of them being expeditiously opened and closed. The suction ends in hold spaces are to be enclosed in strum-boxes having perforations not more than $\frac{3}{8}$ inch in diameter whose combined area is not less than twice that of the suction pipe, and the boxes are to be so constructed that they can be cleared without breaking any joint of the suction pipe. Suction pipes in tunnel wells are to have similar strum-boxes.

6. The main water circulating pumps are to be fitted with direct bilge suction connections, provided with non-return valves, to the lowest level in the machinery space and of a diameter at least two-thirds that of the sea inlet.

Where only one bilge injection is fitted, as in single screw vessels, this suction and the independent power pump direct bilge suction are to be fitted at opposite sides of the engine room, except in the case of vessels having open floors in the machinery space and a rise of floor not less than 5°, when these suctions are to be fitted as near the centre line as practicable.

7. One of the power pumps referred to in **clauses 3 and 4** is to be fitted to draw fron the sea and to deliver water on deck, and the arrangements are to be such that (except in the case of trawlers, tugs, yachts, and other small vessels) the water service can be used at both ends of the vessel at the same time.

8. Two independent means are to be provided for circulating water through the main condenser.

Not less than two sea suctions are to be provided for the pumps supplying circulating water for the main condenser, one suction for the main pump and one for the stand-by pump. These suctions are to be low suctions, and one of them may be the ballast pump sea suction.

Section 5. Twin Screw Vessels.—In vessels fitted with twin screw engines, the main feed pumps and the main engine bilge pumps may be fitted, one of each on each engine, provided they are so connected that each feed pump can deal with the water from both hotwells, and that each bilge pump can draw from all parts of the vessel.

Section 6. 1. **Pipes, General.**—All overboard discharge pipes are to be fitted with discharge valves or cocks, which are to be secured to the plating of the vessel in accessible positions.

2. Pipes which pass through coal bunkers are to be protected efficiently.

3. Lead pipes are neither to be used within coal bunkers nor are they to be attached to bunker bulkheads.

Section 7. Steam Pipes, Valves and Fittings.—1. In all steam pipes provision is to be made for expansion and contraction to take place without unduly straining the pipes. Where the provision for expansion is by means of bends in the pipes the various lengths of pipes are to be made short of the designed lengths by amounts equal to about half the calculated expansion at the temperature of the steam.

2. **Drainage of Steam Pipes.**—Suitable provision is to be made for draining all steam pipes. The number and position of the drain cocks or valves are to be such that water may be efficiently drained from any portion of the steam pipes or valve chests, and arrangements are to be made for ready access to the drain cocks or valves.

3. For the thicknesses and tests of copper, iron, or steel steam and other pipes (*see* **Section 14**).

4. Pipes conveying steam should not be led through spaces which may be used for cargo, except with the approval of the Committee. If these pipes are led through shaft tunnels or duct keels, they should be efficiently secured and insulated.

5. Valves and fittings subjected to steam pressures exceeding 150 lbs. per sq. inch or to steam temperatures exceeding 425° F., and main engine stop valve chests, are to be made of steel or other approved material.

Section 8. Steam Turbine Engines.—1. In single screw vessels fitted with steam turbine engines the arrangements are to be such that steam can be led direct to the L.P. Turbine and either the H.P. or L.P. Turbine can exhaust direct to the condenser.

2. Sufficient astern power is to be provided to maintain adequate control of the vessel in all circumstances and for this purpose two astern turbines are to be provided except in single screw vessels, where one astern turbine may be fitted.

3. Emergency Overspeed Governors are to be fitted to turbines for main propelling purposes, to prevent the turbines exceeding the maximum designed speed by more than 15 per cent. Where more than one turbine drives on to the same gear wheel, only one of these turbines need be fitted with an emergency overspeed governor. The governors are to be arranged for tripping by hand.

Arrangements are to be made for the steam to the turbines to be automatically shut off in the event of the failure of the lubricating oil system.

Section 9. Steam engines and turbines intended for driving electric generators are to comply with the requirements of the **Rules for Electric Propelling Machinery, Section 3,** and of the **Rules for Electrical Equipment, Section 2, clauses 1, 12, 16** and **17,** where these are applicable.

Section 10. 1. **Forced Lubrication.**—In all vessels fitted with steam engines above 70 MN in which the lubricating oil is circulated under pressure, two lubricating oil pumps are to be fitted and connected ready for immediate use, each pump being of sufficient capacity for normal power. Where an oil cooler is fitted, the supply of cooling water may be taken from the main condenser cooling water system, or alternatively, the water is to be supplied by two pumps each of adequate capacity for normal power. One of these pumps may be a ballast or general service pump.

2. Where the lubricating oil for main engines is circulated under pressure, provision is to be made for efficiently straining the lubricating oil. Where strainers are on the discharge side of the oil pump, a relief valve, in close circuit, is to be fitted between the pump and the strainer.

The strainers or filters are to be capable of being cleaned without stopping the oil supply to the engine.

COCKS, PIPES, SEA CONNECTIONS AND PUMPING ARRANGEMENTS.

(*See also* **Section 34** of the **Rules for Steel Vessels.**)

Section 11. 1. All sea cocks or valves are to be fitted as far as practicable in easily accessible places above the level of the stokehold and engine room platforms. In all cases, these fittings are to be readily visible and their spindles are to extend above the level of the platform. The hand wheels of main and bilge injection valves are to be situated not less than 18 inches above the lower platform.

2. All suction and discharge valves and cocks on the plating of the vessel or on the plating of fabricated steel water boxes attached to the shell plating are to be secured by bolts tapped into the plating and fitted with countersunk heads or by studs screwed into heavy steel pads fitted to the plating. These studs are not to penetrate the plating.

Where the valves or cocks are over 3 inches bore they are to be made of steel, or other approved material. Steel valves are to be suitably protected against wastage.

3. Where sea valves are provided with clearing connections from steam or compressed air lines, the scantlings of the valves and the valve stools, if fitted, are to be suitable for the maximum pressure to which the valves or stools may be subjected.

Ship side valves for ships intended to have the notation "Strengthened for Navigation in Ice," are to comply with the requirements of **Section 40, clause 7,** of **Rules for Steel Ships.**

4. All suction and discharge valves and cocks on the plating of the vessel are to be fitted with spigots passing through the plating.

For blow-off cocks on the plating of the ship, see **Section 20, clause 3.**

5. (*a*) The arrangement of pumps, valves and their connections is to be such as to prevent the possibility of water passing from the sea or from water tanks into the cargo or machinery spaces, or from one compartment to another. To effect this requirement, the bilge suction valves of any pump having also suctions from the sea or water tanks are to be of non-return type, or a cock is to be fitted which cannot connect the sea or water tanks to the bilges or main bilge line. Valves in all bilge distribution boxes are to be of the non-return type.

(*b*) All cocks and valves in connection with bilge and ballast suction pipes unless otherwise specifically mentioned in the Rules, are to be fitted in places where they are at all times accessible.

Bilge cocks, valves and mud-boxes are to be fixed in readily accessible places above the stokehold, engine room and tunnel platforms.

(*c*) All pipes from the pumps which are required for draining cargo or machinery spaces are to be entirely distinct from pipes which may be used for filling or emptying spaces where water is carried.

RULES FOR SHAFTS.

Section 12. 1. **General.**—(*a*) All shafts are to be turned all over and are to be examined when rough turned and when finished.

(*b*) Gauges of an approved description for testing the truth of the crank shafts of Reciprocating Engines are to be supplied with all new engines, and adjusted in the presence of the Surveyor. Where Steam Turbine Engines are fitted, gauges for testing the truth of the rotor, pinion and gear wheel shafts are to be supplied, and adjusted in the presence of the Surveyor.

2. **Materials for Shafts.**—(*a*) Shafts may be forged from ingot steel, wrought iron bars piled, or scrap wrought iron, and they may be wrought by hammer, press, or where in straight lengths, by rolling mill.

(*b*) If scrap is used it must be of uniform quality and be thoroughly cleansed. A mixture of iron and steel scrap is not permitted in any case.

(*c*) Where ingot steel is used for shafts it is to comply generally with the requirements of **Section 10** of the **Rules for the Quality and Testing of Materials.**

(*d*) Where ingot steel shafts are made by rolling and the couplings are formed from the shafts by upsetting, the test pieces may be cut from the outer edges of the couplings.

3. **Materials for Couplings.**—(*a*) Couplings of wrought iron shafts may be welded to the body of the shaft, but those of ingot steel shafts are to be forged from the solid or by upsetting the ends by hydraulic pressure.

(*b*) Couplings where separate from the shaft, may be forged from ingot steel or wrought iron ; or they may be steel castings.

4. **Materials for Crank Shaft Webs.**—(*a*) Webs of built crank shafts may be forged or rolled from ingot steel or wrought iron ; or they may be steel castings.

(*b*) The material of rolled or forged steel webs and the test results are to comply with the **Rules for the Quality and Testing of Ingot Steel Forgings,** and the test pieces are to be taken crosswise from the webs as rolled or forged.

(*c*) The material of cast steel webs is to be such that the tensile breaking strength is between the limits of 28 and 35 tons per square inch with a minimum elongation of 20 per cent measured on a standard test piece, and in no case is the sum of the tensile breaking strength and the percentage of elongation to be less than 53.

Section 13. 1. **Dimensions of Shafts.**—The dimensions of the shafts of steam engines are not to be less than those given by the following formulæ. The formulæ do not, however, take into consideration the possibility of severe torsional vibration stresses arising in the shafting and where the circumstances are such as to indicate that critical peeds will occur within the range of working speeds, the sizes of shafting are to be specially submitted for the consideration of the Committee.

2. **Steam Reciprocating Engines.**—The diameter of the intermediate shafts is not to be less than that given by the following formula :—

Diameter of intermediate shaft, in inches =

$$\sqrt[3]{\frac{D^2 \times S \times WP}{C\ (r + 2)}}$$

where **D** is the diameter in inches of the low pressure cylinder or the equivalent diameter where two or more low pressure cylinders are fitted

S is the stroke of the piston in inches,

WP is the working pressure in the boiler in lb. per square inch,

r is the ratio of the areas of the low pressure cylinder or cylinders to that of the high pressure cylinder or cylinders,

C is a coefficient given in the following Table :—

COMPOUND, TRIPLE, OR QUADRUPLE EXPANSION RECIPROCATING ENGINES.	VALUES OF "C."	
	Ocean Going and Home Trade Vessels.	Vessels trading on Estuaries. Rivers, Lochs and Lakes.
2 cranks at 90° ...	1900	2100
2 cranks at 180° ...	1350	1500
3 cranks at 120° ...	2150	2400
4 cranks balanced...	2150	2400
4 cranks at 90° ...	2100	2300

3. **Crank Shafts.**—The diameter of the crank shafts is not to be less than 1·05 times that required for the intermediate shaft.

4. **Crank Webs of Built Shafts.**—(*a*) The dimensions of the crank webs of built shafts are not to be less than those given by the following formulæ :—

$$h = \cdot 625 \times d$$

$$t = \sqrt{\frac{\cdot 12 \times d^3}{h}}$$

where h is the thickness of the web, measured parallel to the axis, in inches,

t is the thickness of metal around the eyeholes, measured radially, in inches,

d is the diameter required for the crank shaft in inches.

(*b*) Crank webs are to be securely shrunk on the body pieces and crank pins. If dowels are not fitted at the junction of the body pieces and webs, the yield point of the material of the webs is to be not less than 14 tons per square inch, and the shrinkage allowance is to be between $\frac{1}{550}$ and $\frac{1}{700}$ of the diameter of the shaft.

5. **Thrust Shafts.**—The diameter at the collars of thrust shafts transmitting torque is not to be less than 1·05 times that required for the intermediate shaft. Thrust shafts may be tapered down outside the collars to the diameter required for the intermediate shaft.

6. **Tube Shafts** (Shafts passing through stern tubes but not carrying the screw propellers).—The diameter of the tube shaft is not to be less than 1·05 times that required for the intermediate shaft, and any part of the shaft within the tube which may be exposed to sea water is not to be less than 1·075 times that required for the intermediate shaft.

7. **Screw Shafts** (Shafts carrying the screw propellers).—(*a*) The diameter of the screw shaft is not to be less than that given by the following formula :—

Diameter of screw shaft, in inches = $d + \frac{P}{C}$

where d is the diameter required for the intermediate shafts, in inches,

P is the diameter of the propeller, in inches,

C = 144 when the shaft is fitted with a continuous liner, or

C = 100 when the shaft is not fitted with a continuous liner.

(*b*) Screw shafts which run in stern tubes may have the end forward of the stern gland tapered down to a diameter, at the coupling flange, of 1·05 times d.

(*c*) Screw shafts for ships intended to have the notation "Strengthened for Navigation in Ice," are to comply with the requirements of **Section 40, clause 5, of Rules for Steel Ships.**

8. **Bronze Liners on Shafts.**—(*a*) The thickness of liners fitted on screw shafts or on tube shafts, in way of the bushes, is not to be less than that given by the following formula :—

$$t = \frac{d + 9 \cdot 25}{32}$$

where t is the thickness of the liner, in inches,

d is the diameter required for the screw or tub shaft under the liner in inches.

(*b*) The thickness of a continuous liner between the bushes is not to be less than $\frac{3}{4}$ t.

(*c*) Continuous liners should be cast in one piece or, if made of two or more lengths, the junctions of the separate pieces are to be made by fusion through the whole thickness of the liner.

(*d*) Liners are to be carefully shrunk on, or forced on to the shafts by hydraulic pressure. Pins are not to be used to secure the liners.

(*e*) If the liner does not fit tightly between the bearings in the stern tube, the space between the shaft and the liner is to be charged or forced with a plastic material insoluble in water and non-corrosive.

(*f*) Effective means are to be provided for preventing water from having access to the shaft at the part between the after end of the liner and the propeller boss.

9. **Stern bush.**—The length of the bearing in the stern bush next to and supporting the propeller is not to be less than four times the diameter required for the screw shaft under the liner.

10. **Couplings.**—(*a*) The diameter of the coupling bolts at the joining faces of the couplings is not to be less than that given by the following formula :—

Diameter of coupling bolts, in inches =

$$\sqrt{\frac{d^3}{3{\cdot}5 \times n \times r}}$$

where d is the diameter required for the intermediate shafts, in inches,

n is the number of bolts in the coupling,

r is the radius of the pitch circle of the bolts, in inches.

(*b*) The thickness of the coupling flanges at the pitch circle of the bolt holes is not to be less than the diameter of the coupling bolts at the face of the coupling The thickness of the screw shaft coupling flange is not to be less than 0·25 of the diameter required for the intermediate shaft.

(*c*) The radius of curvature at the fillet where the flange starts from the shaft should not be less than ·125 the diameter of the shaft adjacent to the flange.

(*d*) Where couplings are separate from the shafts provision is to be made to resist the astern pull.

11. **Bronze propellers.**—Where bronze is used for propellers or propeller blades, it is to comply with the requirements of **Section 11** of the **Rules for Quality and Testing of Materials.**

12. **Steam Turbine Engines and Electric Propelling Motors.**—The diameter of the intermediate shafts is not to be less than that given by the following formula :—

Diameter of intermediate shaft, in inches =

$$\sqrt[3]{\frac{SHP}{R} \times F}$$

Where SHP is the maximum designed shaft horse power,

R is the number of revolutions per minute at that power,

F = 64 for ocean going and home trade vessels,

F = 58 for vessels trading on estuaries, rivers, lochs and lakes.

13. **Wheel Shafts of Geared Steam Turbine Engines.**—(*a*) Where there are two pinions geared into the wheel, opposite, or nearly opposite, to one another, the diameter of the wheel shaft is not to be less than 1·05 times that required tor the intermediate shaft.

(*b*) Where there is only one pinion geared into the wheel, or where there are two pinions which are set to subtend an angle at the centre of the shaft of less than 120°, the diameter of the shaft at the wheel and the adjacent journals is not to be less than 1·1 times that required for the intermediate shaft. Abaft the journals the shaft may be tapered to 1·05 times the diameter required for the intermediate shaft.

14.—**Steam Reciprocating Engines combined with Exhaust Steam Turbines.**

Where steam reciprocating engines are combined with exhaust steam turbines, either by means of mechanical gearing or by electric generators and motors, the diameter of the intermediate shafting is not to be less than that given by the following formula, viz. :—

$$d = \sqrt[3]{\frac{SHP \times 64}{R}}$$

where d = diameter of intermediate shaft in inches,

SHP = 0·9 indicated horse-power, of the reciprocating engines when working with the turbine + ·95 shaft horse-power of the exhaust turbine at the turbine shaft,

R = Revolutions per minute of the main propelling shafting.

In no case is the diameter of the intermediate shafting to be less than that required by the Rules for ordinary reciprocating engines when working without a turbine.

15. For dimensions of thrust, tube, and screw shafts, shaft liners, stern bush, shaft couplings and coupling bolts *see* **clauses 5 to 10.**

STEAM AND OTHER PIPES.

Section 14. 1. Pipes made from the electro deposition of copper on a mandril are not to used for steam, feed delivery, blow-off or scum.

2. All copper steam, feed, blow-off and scum pipes are to be properly annealed before fixing in place.

3. All copper pipes used for steam, feed, blow-off and scum purposes subject to a pressure over 75 lb. per square inch are to be solid drawn.

4. Steam pipes intended for a working pressure over 180 lb. per square inch are not to be of copper when the internal diameter exceeds 5 inches. Copper pipes are not to be used for superheated steam.

5. All copper steam pipes on completion and prior to being fitted in place are to be subjected to an hydraulic test of at least twice the working pressure to which they will be subjected.

6. All copper feed delivery pipes are to be hydraulically tested to at least $2\frac{1}{2}$ times the working pressure of the boilers.

7. The working pressure to be allowed on copper pipes is to be determined by the following formula :—

$$WP = \frac{(t - 3) \times F}{D}$$

Where **WP** is the working pressure in lb. per square inch,

D is the internal diameter in inches,

t is the thickness in 100ths of an inch,

F for solid drawn steam pipes = 60,
for solid drawn feed pipes = 48,
for brazed steam pipes = 45,
for brazed feed pipes = 36.

8. Where copper pipes are bent they are to be made thicker than required by **clause 7** to provide for the thinning at the bend. In no case is the radius of curvature at the centre line of the pipe to be less than twice the external diameter of the pipe.

9. Steam and other pipes may be made of wrought iron or of wrought steel.

10. The process of welding the seams of iron or steel pipes is to be such that it is done by hammering or rolling the joint.

11. On completion of any work on iron or steel pipes which involves heating whether for welding the joint, bending the pipe, or for any other purposes, the pipes are to be carefully annealed.

12. Where steam and other pipes are made of steel, the material is to comply with the requirements of **Section 16** of the **Rules for Quality and Testing of Materials.**

13. Feed pipes if made of steel are to be solid drawn, cold finished.

14. All iron or steel steam pipes prior to being fitted in place are to be subjected to an hydraulic test of three times the working pressure to which they will be subjected.

The test pressure need not, however, be more than 1,000 lb. per square inch above the working pressure.

15. All iron or steel feed delivery pipes are to be hydraulically tested to four times the working pressure of the boilers.

The test pressure need not, however, be more than 1,000 lb. per square inch above the working pressure.

16. The working pressure to be allowed upon iron or steel steam and feed pipes is to be determined from the following formulæ :—

a. For solid drawn cold finished steel steam pipes,

$$WP = \frac{(t - 10)}{D} \times 120$$

b. For solid drawn hot finished steel steam pipes,

$$WP = \frac{(t - 12)}{D} \times 120$$

c. For lap-welded steam pipes of iron or steel whether with or without covering straps,

$$WP = \frac{(t - 12)}{D} \times 90$$

d. For feed delivery pipes,

$$WP = \frac{(t - 8)}{D} \times 100$$

Where **WP** is the working pressure in lb. per square inch to which the steam pipes will be subjected, and in the case of feed delivery pipes is the boiler pressure,

D is the internal diameter of the pipes in inches ;

t is the thickness in 100ths of an inch.

17. Steam pipe lines not designed to withstand the maximum boiler pressure are to be fitted with a suitable pressure reducing device followed on the low pressure side by a pressure gauge and a safety valve having sufficient discharge capacity to protect the piping against excessive pressure.

18. **Attachment of Flanges to Steel Pipes.**—(*a*) Flanges may be attached to pipes by means of screwing and expanding or welding.

(*b*) Firms proposing to attach flanges or branches to pipes by means of welding should, in the first instance, in the presence of the Surveyors, weld specimens which are to be cut up for the purpose of ascertaining that the weld metal is sound and the penetration satisfactory.

Periodically check tests similar to the foregoing are to be carried out at the Surveyors' discretion.

(*c*) Where flanges are welded-on by the oxy-acetylene or metal arc processes, the welding is to be carried out by means of approved filler rods, or electrodes.

(*d*) All pipes provided with welded-on flanges and intended for a working pressure greater than 100 lb. per square inch (with the exception of types (E) and (G)—Fig. 1.) are to be efficiently heat treated on completion of the welding.

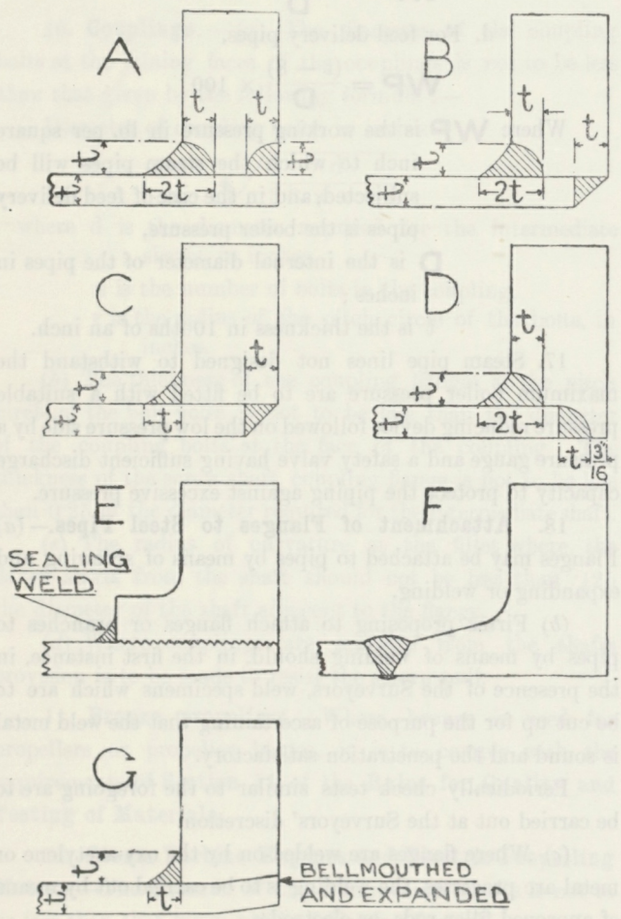
(*e*) Where flanges are secured by screwing, the pipe and flange are to be screwed with a vanishing thread and the

diameter of the screwed portion of the pipe over the thread must not be less than the outside diameter of the unscrewed pipe. After the flange has been screwed hard home the pipe is to be expanded into the flange and may be provided with a sealing weld. *See* type (E) Fig. 1.

The vanishing thread on a pipe is to be not less than three pitches in length, and the diameter at the root of the thread is to increase uniformly from the standard root diameter to the diameter at the top of the thread. This may be produced by suitably grinding the dies, and the flange should be tapered out to the same formation.

(*f*) Flanges may be attached by any of the methods shown in Fig. 1.

FIG. 1. TYPICAL ACCEPTABLE METHODS OF SECURING FLANGES TO STEEL PIPES.



NOTE:—The proportions indicated for the welds are minima only.

Types (A), (D) & (F).—Acceptable for all pressure and temperature conditions.

Type (E)—Acceptable for steam pipes having a maximum pressure of 450 lb. per square inch and maximum temperature of 750°F., also for feed piping having a maximum pressure of 600 lb. per square inch.

Type (B).—Acceptable for steam pipes having a maximum pressure of 250 lb. per square inch and maximum temperature of 750° F., also acceptable for feed piping having a maximum pressure of 350 lb. per square inch.

Type (G)—Acceptable for a maximum pressure of 150 lb. per square inch and maximum temperature of 500° F.

Type (C)—Acceptable for maximum pressure of 100 lb. per square inch.

19. Where branches are attached by means of welding to steam or other pressure pipes, suitable reinforcement is to be provided in way of the branch or the thicknesses of both branch and pipe are to be increased to maintain the strength of the pipe.

CYLINDRICAL BOILERS.

Section 15. 1. **General.**—In the design and construction of Marine Boilers the following conditions are to be observed:—

2. Where the joints in the shells of boilers are made by means of welding, the shells are to be constructed in accordance with the **Rules for Welded Pressure Vessels.**

3. Where the joints in the shells of boilers are riveted, the shells are to be constructed in accordance with **Section 24.**

4. All steel plates which are welded, dished, flanged or locally heated are to be afterwards efficiently annealed.

5. Butt straps are to be cut from plates and not from rolled strips.

6. All rivet holes are to be drilled, and as far as possible they are to be drilled in place. After drilling the plates the burrs are to be removed and the faying surfaces of the plates cleaned, and the sharp outer edges of holes also removed.

7. Steel stays are not to be welded. If plus threads are desired, the ends of the stay bars may be upset or the bars may be drawn down in the central portions from bars originally of the size of the ends. In either of these two cases the bars are to be subsequently annealed throughout. In double ended boilers the through longitudinal stays are to be supported at or near the middle of their length.

8. Screw stays of combustion chambers where fitted with nuts, are to be, as far as possible, normal to the chamber plates. Where this is not possible they are to be fitted with taper washers to provide a fair bed for the nuts.

9. Nuts to screw stays in combustion chambers are to be not less than $\frac{3}{4}$ inch thick for stays up to $1\frac{1}{2}$ inches

diameter over threads, $\frac{7}{8}$ inch thick for $1\frac{5}{8}$ and $1\frac{3}{4}$ inch stays, 1 inch thick for $1\frac{7}{8}$ and 2 inch stays, and $1\frac{1}{8}$ inches thick for stays over 2 inches in diameter. The nuts are to be made of solid mild steel or of iron which is to be without weld. The nuts for longitudinal stays are to be to the British standards appropriate to the diameters of the stays, the outside nuts having the thickness therein provided for ordinary nuts, and the inside nuts having the thickness provided for lock nuts.

10. Screw stays $1\frac{1}{4}$ inches in diameter and upwards should have 9 threads per inch, and all stays 2 inches in diameter and above passing through plates, and secured by nuts on each side of the plate, should have not more than 6 threads per inch.

11. Where jointed longitudinal stays are fitted between the front and back tube plates they are to be fitted with pins having an effective sectional area not less than 25 per cent in excess of that of the stay. The pins may be slack in the holes, the total slackness being not more than $\frac{1}{16}$ inch. The pins are to be as close as possible to the shoulder of the eye forging. The shoulder of the forging is to to have a diameter not less than 1 inch greater than the diameter of the hole.

Section 16. 1. **Dampers and Baffles.**—Boilers, whether main or auxiliary, in which fuel oil only is used are not to be fitted with a damper, or other possible means of obstruction to draught, in the uptake or funnel.

If the boilers are to use coal and oil fuel alternately, the uptake or funnel dampers, if fitted, must be provided with a suitable device whereby they may be securely locked in the fully open position.

2. The end plates in the steam space in way of uptakes are to be shielded from contact with the heated gases.

Section 17. 1. **Access Arrangements.**—(*a*) Manholes in cylindrical shells are to have their shorter axes arranged longitudinally. Where the cylindrical shell is cut for a manhole, compensation is to be provided and is to be such that the strength in way of the hole is not less than that required for the longitudinal joint.

(*b*) Where a flat plate is flanged to stiffen it at a manhole or sight hole, to permit the same working pressure as would be allowed upon an unpierced plate the depth of the flange measured in inches from the outer surface is to be at least equal to $\sqrt{t \times w}$ where t is the thickness of the plate in inches and w is the minor axis of the hole in inches.

2. The doors to manholes, mudholes, and sight holes are to be built up or pressed to shape and annealed, or made from one thickness of plate with a machined recess for the jointing material. Their spigot part or the recess is not to have a greater clearance than $\frac{1}{16}$ inch all round, *i.e.*, the axes are not to be less than $\frac{1}{8}$ inch smaller than the holes in which they are fitted.

3. The studs for securing all doors are to be screwed through the plate, and they are to be fitted with nuts on the inside or bolts may be used screwed through the plate with the heads inside.

4. All boilers are to be provided, where possible, with means for ingress to permit of examination and cleaning of the inner surfaces of plates and tubes exposed to flame. Where the boilers are too small to permit of this there are to be sight holes and mudholes sufficiently large and numerous to permit of the inside being satisfactorily cleaned.

5. Where the cross tubes of vertical boilers are large there is to be a sight hole in the shell opposite to one end of each tube sufficiently large to permit the tube to be examined and cleaned. These sight holes are to be in positions accessible for that purpose.

Section 18. Hydraulic Tests.—In all new boilers working at pressures up to 100 lb. per square inch the hydraulic test is to be twice the working pressure. For boilers working at pressures greater than 100 lb. per square inch the hydraulic test pressure is to be $1\frac{1}{2}$ times the working pressure plus 50 lb. per square inch.

Section 19. 1. **Water Gauges and Test Cocks.**—Every boiler is to be fitted with at least two independent means of indicating the water level in it, and have marked on it in a contiguous position, easily seen, the level of the highest part of the combustion chamber. One of these means is to be a glass gauge or an equivalent. The other may be a set of test cocks.

(In the case of boilers of tugs, tenders, coasting and other small vessels engaged on short voyages, and in that of vertical boilers, the marking of the level of the highest part of the combustion chamber may be omitted.)

2. Test cocks, where practicable, are to be fitted direct on the boiler shell. A set is to consist of at least three cocks except in boilers 7 feet 6 inches in diameter and under when there may be two. For vertical boilers above 7 feet high, the set of test cocks is to consist of at least three.

3. All single-ended boilers, 16 feet mean diameter or over, are to be fitted with a glass water gauge on each side. Single-ended boilers under 16 feet in diameter are to be fitted with one glass water gauge and one set of test cocks, or the equivalent of the latter,

4. All double-ended boilers are to be fitted with a glass water gauge at, or near, each end on opposite sides and a set of test cocks at each end, or the equivalent of the latter.

5. The cocks of all water gauges are to be accessible from positions free from danger in the event of the glass breaking.

6. If the water gauges are not fitted directly to the shell of the boiler but to stand pillars or columns, it is desirable that these pillars or columns should be bolted directly to the shell of the boiler. If they are connected to the boiler by means of pipes the pipes are to be fitted with terminal cocks, not valves, secured direct to the boiler shell. For boilers exceeding 10 feet in diameter the pillars are not to be less than $2\frac{1}{2}$ inches and the connecting pipes not less than $1\frac{1}{2}$ inches internal diameter. For boilers exceeding 7 feet 6 inches but not exceeding 10 feet in diameter the pillars are not to be less than 2 inches and the pipes not less than $1\frac{1}{4}$ inches internal diameter, and for boilers 7 feet 6 inches in diameter and under the pillars are not to be less than $1\frac{3}{4}$ inches and the pipes not less than 1 inch internal diameter. The upper ends of the connecting pipes are to be arranged so that there is no pocket or bend where an accumulation of water from the condensation of the steam can lodge. They should not pass through the uptake if they can be otherwise arranged. If, however, this condition cannot be complied with, they may pass through it by means of a passage at least 2 inches clear of the pipe all round, open for ventilation.

7. A **Salinometer Cock or Valve** is to be fitted direct to each boiler in a convenient position. It must not be on the water gauge stand-pipe.

8. **Pressure Gauges.**—Each boiler is to be provided with a separate steam pressure gauge. Double-ended boilers are to be provided with a pressure gauge at each end. The gauges are to be placed where they are easily seen.

9. **Feed Checks.**—Each boiler is to be fitted with at least two independent means of feed, each with its own check valve. In auxiliary or winch boilers one of the means of feed may be an injector.

Section 20. 1. **Blow-off and Scum Valves.**—Each boiler is to be fitted with a blow-off valve secured direct to the shell. The valve and its connections to the sea need not be more than $1\frac{1}{2}$ inches in diameter, and may be generally about $\frac{1}{10}$ inch in diameter for each foot in diameter of the boiler. It is, however, to be not less than $\frac{3}{4}$ inch in diameter. Vertical boilers are to be fitted with a blow-off cock or valve.

2. Blow-off valves and scum valves (where these latter are fitted) of two or more boilers may be connected to one common discharge, but where thus arranged there are to be screw-down non-return valves fitted for each boiler to prevent the possibility of the contents of one boiler passing to another.

3. The blow-off cock or valve on the ship's side is to be fitted above the level of the stokehold plates, in an accessible position, and is to be arranged so that it can be readily seen whether it is open or shut. The cock handle is not to be capable of being removed unless the cock is shut, and if a valve is fitted the wheel is to be fixed to the spindle. The cock or valve is to be fitted with a spigot passing through the plating and a protection ring on the outside.

Section 21. Stop Valves.—One main stop valve is to be fitted to each boiler secured direct to the shell. There are to be as few auxiliary stop valves as possible so as to avoid piercing the boiler shell more than is absolutely necessary. The arrangement, however, is to be such that where more than one boiler is fitted it is possible to supply the steam whistle, the steam steering gear, and the electric light machinery from at least two boilers.

Section 22. 1. **Safety Valves.**—At least two safety valves are to be fitted to each boiler. They are to be arranged so that the springs and valves are cased in, that the valves cannot be overloaded when steam is up, that they can be lifted by easing gear, and turned round on their seats by hand, and in case of fracture of springs they cannot lift out of their seats. Easing gear is to be arranged to lift all the safety valves on a boiler together, and is to be workable from some accessible place, free from steam danger.

2. Vertical boilers having 100 square feet, or more, of total heating surface are to be fitted with two safety valves each not less than 1·5 inches diameter; those having less than 100 square feet may have one valve not less than 2 inches diameter.

3. All the safety valves of each boiler may be fitted in one chest, which is to be separate from any other valve chest and is to be connected direct to the boiler by a strong and stiff neck, the passage through which is to be

of not less cross-sectional area than one-half the aggregate area of the safety valves in the chest. Each safety valve chest is to be provided with a means by which it can be drained ; the drain pipe is to be led to the bilge or to a tank, clear of the boiler.

4. (*a*) The minimum aggregate area of the safety valves of the ordinary type for saturated steam fitted to each boiler, whether coal fired or oil fired, and whether working under natural, forced, or induced draught, is to be found by the following formula :—

$$\left.\begin{array}{l}\text{Aggregate area of safety}\\ \text{valves in square inches.}\end{array}\right\} = \frac{\text{T.H.S.} \times \text{E}}{(\text{p} + 15) \times 4{\cdot}8}$$

where T.H.S. is the total external surface in square feet of the tubes and other parts of the boiler exposed to heat, so as to cause evaporation,

p is the working pressure in lb. per square inch.

E is the estimated evaporation in lb. per square foot of heating surface (T.H.S.) per hour *with a minimum value of* 6.

(*b*) For superheated steam, the aggregate area of the safety valves is to be found by the following formula :—

$$A_s = A \times \left(1 + \frac{T}{1000}\right)$$

where A_s is the aggregate area of the safety valves for superheated steam, in square inches.

A is the aggregate area of the safety valves found by the formula in paragraph (*a*),

T is the degree of superheat, in degrees Fahr.

(*c*) An approved type of safety valve of equally good and reliable design may be fitted in lieu of those described in the Rules.

(*d*) In the case of high lift and "Improved" high lift safety valves of approved types, the aggregate area of safety valves, as calculated from either of the foregoing formulæ, may be reduced by not more than one third and one half respectively.

5. The waste-steam pipe and the passages leading to it are to have a cross-sectional area not less than 1·1 times the combined areas of the safety valves as given by the above formula.

6. All safety valves are to be set under steam to a pressure not greater than 3 per cent. above the approved working pressure of the boiler. During a test of 15 minutes with the stop valves closed and under full firing conditions the accumulation of pressure is not to exceed 10 per cent of the loaded pressure. During this test no more feed-water should be supplied than is necessary to maintain a safe-working water level.

Section 23. Boiler Mountings. 1.—All Boiler mountings are to be subjected to an hydraulic test of twice the working pressure with the exception of feed check valves which are to be tested to $2\frac{1}{2}$ times the working pressure. The test pressures need not, however, be more than 1,000 lb. per square inch above the working pressure. Valves over $1\frac{1}{2}$ inches diameter are to be fitted with outside screws and the covers are to be secured by bolts or studs. All valves are to be arranged to be shut with a right-hand motion of the wheels.

2. All cocks and valves connected to the boiler are to be such that it is seen without difficulty whether they are open or shut. Where boiler mountings are secured by studs, the studs are to have a full thread holding in the plate for a length of at least one diameter. If the stud hole penetrates the whole thickness of the plate the stud is to be screwed right through the plate and is to be fitted with a nut inside the boiler. Where bolts are used for securing mountings they are to be screwed right through the plate with their heads inside the boiler.

3. Where a superheater is fitted which can be shut off from the boiler it is to be provided with a separate safety valve fitted with easing gear. The valve as regards construction is to comply with the regulations for ordinary safety valves, but the easing gear may be fitted to be workable from the stokehold only. The superheater is also to be fitted with a drain cock or valve to free it from water when necessary.

4. Safety valve chests and other boiler and superheater mountings subjected to pressures exceeding 150 lbs. per sq. inch or to steam temperatures exceeding 425° F. and boiler blow down fittings, are to be made of steel or other approved material.

RULES FOR DETERMINING THE WORKING PRESSURE TO BE ALLOWED IN NEW BOILERS.

NOTE.—Where the joints in the shells of boilers are made by means of welding the shells are to be constructed in accordance with the **Rules for Welded Pressure Vessels.**

RIVETED CYLINDRICAL SHELLS.

Section 24. 1. For the cylindrical shells of steel marine boilers the maximum working pressure (which is

designated by WP and is in lb. per square inch) to be allowed is to be calculated from the following formulæ :—

Where the thickness of the shell plates does not exceed $1\frac{3}{4}$ inches.

$$\mathbf{WP} = \frac{(t-2) \times \mathbf{S} \times \mathbf{J}}{\mathbf{C} \times \mathbf{D}}$$

Where the thickness of the shell plates exceeds $1\frac{3}{4}$ inches, and the longitudinal seams are made with double butt straps.

$$\mathbf{WP} = \frac{t \times \mathbf{S} \times \mathbf{J}}{2{\cdot}85 \times \mathbf{D}}$$

In the above formulæ

t is the thickness of the shell plates in 32nds of an inch.

S is the minimum tensile strength of the steel shell plates in tons per square inch.

J is the percentage of strength of the longitudinal seams calculated by the methods described hereafter,

C is a coefficient, which is 2·75 where the longitudinal seams are made with double butt straps, 2·83 where the longitudinal seams are made with lap joints and are treble riveted, 2·9 where they are made with lap joints and are double riveted and 3·3 where they are made with lap joints and are single riveted,

D is the inside diameter of the outer strake of plating of the cylindrical shell measured in inches.

2. The percentage of strength of a riveted joint (**J**) is found from the following formulæ (i), (ii), (iii) : (i) and (ii) are applicable to any type of joint, (iii) is applicable only to that type of joint in which the number of rivets in the inner rows is double that in the outer row. The lowest value given by the application of these formulæ is to be taken as the percentage of strength of the joint.

(i) Percentage of strength of plate at joint as compared with solid plate $= \frac{100\,(p-d)}{p}$

(ii) Percentage of strength of rivets as compared with solid plate.

$$= \frac{100\,(\mathbf{S_2} \times a \times n \times \mathbf{C})}{\mathbf{S_1} \times p \times \mathbf{T}}$$

(iii) Percentage of combined strength of the plate at the inner row of rivet holes and of the rivets in the outer row

$$= \frac{100\,(p-2\,d)}{p} + \frac{100\,(\mathbf{S_2} \times a \times \mathbf{C})}{\mathbf{S_1} \times p \times \mathbf{T}}$$

where p = pitch of rivets at outer rows in inches,

d = diameter of rivet holes in inches,

a = sectional area of one rivet in square inches,

n = number of rivets which are fitted in the pitch p,

T = thickness of plate in inches,

C = 1·0 for rivets in single shear as in lap joints

C = 1·875 for rivets in double shear as in double butt-strapped joints,

$\mathbf{S_1}$ = minimum tensile strength of plates in tons per square inch,

$\mathbf{S_2}$ = shearing strength of rivets, which is taken generally to be 23 tons per square inch, and may be 85 per cent. of the minimum tensile strength of the rivet bars.

3. Where the longitudinal seams are fitted with double butt-strapped joints, the outer butt strap is to be at least 0·625 of the strength of the plate, and is to be of sufficient thickness to permit of efficient caulking of its outer edges. The inner butt strap is to be $\frac{4}{32}$ inch thicker than this.

In cases where the number of rivets in the inner rows is double the number in the outer row, this will require the thickness of the outer strap to be

$$t_o = \frac{5 \times (p-d)}{8 \times (p-2\,d)} \times \mathbf{T},$$

and that of the inner strap to be at least

$$t_n = \frac{5 \times (p-d)}{8 \times (p-2\,d)} \times \mathbf{T} + \tfrac{4}{32} \text{ inch.}$$

4. In all cases the clear space between a rivet hole and the edge of a plate is not to be less than the diameter of the rivet holes, *i.e.*, the centre of the rivet hole is to be at least $1\frac{1}{2}$ diameters distant from the edge of the plate.

In joints whether lapped or fitted with butt straps, in which there are more than one row of rivets and in which there is an equal number of rivets in each row, the distance between the rows of rivets is not to be less than 0·33 p + 0·67 d with zigzag riveting, or 2 d with chain riveting.

In joints in which the number of rivets in the outer rows is one-half of the number in each of the inner rows, and in which the inner rows are chain riveted, the distance between outer rows and the next rows is not to be less than 0·33 p + 0·67 d or 2 d, whichever is the greater, and the distance between the rows in which there are the full number of rivets is not to be less than 2 d.

In joints in which the number of rivets in the outer rows is one-half of the number in each of the inner rows and in which the inner rows are zigzag, the distance between the outer rows and the next rows is not to be less than 0·2 p + 1·15 d, and the distance between the rows in which there are the full number of rivets is not to be less than 0·165 p + 0·67 d.

In the above p is the pitch of the rivets in the outer rows.

5. The maximum pitch of the rivets in the longitudinal joints of boiler shells is to be—

Maximum pitch in inches = C × T + $1\frac{5}{8}$ inches where T is the thickness of the plate in inches and C is a coefficient as given in the following Table :—

Number of Rivets per pitch.	Coefficients for Lap Joints.	Coefficients for Double Butt-strapped Joint.
1	1·31	1·75
2	2·62	3·50
3	3·47	4·63
4	4·14	5·52
5	—	6·00

6. If holes are cut in the cylindrical shells of boilers for fixing of mountings, the diameters of the holes being greater than $2\frac{1}{2}$ times the thickness of the shell plating plus $2\frac{3}{4}$ inches, compensation is to be fitted as in the case of manholes. (*See* **Section 16, clause 1, paragraph** (*a*).)

7. Where more than three screw stays pierce the cylindrical shell in a horizontal line, if d is their diameter and p the pitch, $\frac{100\ (p - d)}{p}$ should not be less than the percentage of strength required for the shell longitudinal joints. If this is not possible, stays are to be arranged out of line with one another longitudinally.

8. The riveting of the seams joining the end plates to the cylindrical shell is not to be less than 42 per cent. of that of the solid shell plate. Where the shell plates exceed $\frac{5}{8}$ inch in thickness the seams connecting the shell plates to the end plates are to be at least double riveted. Where the shell plates exceed $\frac{1}{2}$ inch in thickness the intermediate circumferential seams of double-ended boilers are to be at least double riveted.

9. The circumferential seam at or near the middle of the length of single-ended boilers is to have a strength of joint not less than 60 per cent. of the solid plate. The inner circumferential seams of double-ended boilers are to have a strength of joint not less than 62 per cent. of the solid plate. In any case there are to be at least three rows of rivets where single-ended boilers have shell plates over $1\frac{3}{8}$ inch in thickness and where double-ended boilers have shell plates over $1\frac{3}{16}$ inch in thickness.

10. The circumferential seams of the shells of vertical boilers are to have a strength of not less than 42 per cent. of the solid plate. Where these seams are not complete circles, and where the shell plates exceed $\frac{5}{8}$ inch in thickness, the riveting is to be at least double.

Furnaces.

Section 25. 1. The working pressure to be allowed on corrugated furnaces is to be determined by the following formula :—

$$WP = \frac{C\ (t - 1)}{D}$$

where D is the external diameter measured at the bottom of the corrugations in inches,

t is the thickness of the furnace plate in 32nds of an inch, measured at the bottom of the corrugation or camber,

C is a coefficient which is 480 for the Fox, Morison, Deighton, Purves, and other similar furnaces, and is 510 for the Leeds Forge Bulb Suspension furnace.

2. The working pressure to be allowed on plain furnaces or furnaces strengthened by the Adamson or other joints, and on the cylindrical bottoms of combustion chambers, is to be determined by the following formulæ, the least pressure obtained by either formula being taken :—

$$WP = \frac{C\ (t - 1)^2}{(L + 24) \times D}$$

$$\text{or } WP = \frac{C_1}{D} \times [10\ (t - 1) - L]$$

where D is the external diameter of the furnace or combustion chamber in inches,

t is the thickness of the furnace plate in 32nds of an inch,

L is the length of the furnace or of combustion chamber bottom or the length between points of substantial support, in inches, measured from the centres of rivet rows or from the commencement of flange curvature, whichever is applicable,

C is 1450 where the longitudinal seams are welded and 1300 where they are riveted,

C_1 is 50 where the longitudinal seams are welded and 45 where they are riveted,

WP is the working pressure in lb. per square inch.

3. Where the furnaces are tapered the diameter to be taken for calculation purposes is to be the mean of that at the top, and of that at the bottom where it meets the substantial support from flange or ring. The length for the same purpose is to be the distance from the centre of the row of rivets connecting the crown to the body of the furnace to the substantial support at the bottom of the furnace, or to a row of screwed stays connecting the furnace to the shell, provided the pitch of stays at the furnace does not exceed 14 times the thickness of the furnace plate where the stays are riveted at their ends, and 16 times where they are fitted with nuts. Such screwed stays are to be in diameter over the threads not less than 2·25 times the thickness of the furnace plate.

4. Where the furnaces are spherical in form and convex upwards at their tops, and are without support from stays of any kind :—

$$WP = \frac{275\ (t - 1)}{R}$$

where t is the thickness of the top plate in 32nds of an inch,

R is the outer radius of curvature of the furnace in inches.

5. The working pressure to be allowed on internal uptakes of vertical boilers is to be determined by the following formulæ, the least pressure obtained by either formula being taken :—

$$WP = \frac{C\ (t - 5)^2}{(L + 24) \times D}$$

$$\text{or } WP = \frac{C_1}{D} \times [10\ (t - 5) - L]$$

where D is the external diameter of the uptake in inches,

t is the thickness of the uptake in 32nds of an inch,

L is the length of the uptake between points of substantial support, in inches, measured from the centres of the rivet rows,

C is 1450 where the longitudinal seams are welded and 1300 where they are riveted,

C_1 is 50 where the longitudinal seams are welded and 45 where they are riveted,

WP is the working pressure in lb. per square inch.

6. The thickness of cross tubes in cross tube boilers shall be determined from the following formula, but shall in no case be less than $\frac{3}{8}$ inch.

$$t = \frac{WP \times D}{200} + 7$$

where t = the minimum thickness in 32nds of an inch,

WP = the working pressure in lb. per sq. inch,

D = the internal diameter of the cross tube in ins.

7. For the ogee ring which connects the bottom of the furnace to the shell, and sustains the whole load on the furnace vertically :—

$$WP = \frac{140\ (t - 1)^2}{D \times (D - d)}$$

where t is the thickness of the ogee ring in 32nds of an inch,

D is the inside diameter of the boiler shell in inches,

d is the outside diameter of the lower part of the furnace where it joins the ogee ring in inches.

8. Furnaces, plain or corrugated, are not to exceed $\frac{13}{16}$ inch in thickness.

Flat Plates supported by Stays secured in various ways.

Section 26. 1. The working pressure to be allowed on flat plates supported by stays is to be calculated by the following formula :—

$$WP = \frac{(t - 1)^2 \times C}{a^2 + b^2}$$

In this formula and in that in clauses 8 to 11

WP is the working pressure in lb. per square inch,

t is the thickness of the flat plate in 32nds of an inch,

t_w is the thickness of the washers, strips, or doublings employed also in 32nds of an inch,

a is the distance apart of the rows of stays in inches,

b is the pitch of the stays in the rows in inches,

C is a coefficient which varies with the method of fixing the stays as follows :—

Where the plates are exposed to flame and the stays are screwed into the plate and their ends are riveted over C = 50. Where the plates are not exposed to flame and the stays are screwed into the plate and their ends are riveted over C = 57. In these cases the thickness of the plate is to be at least half the diameter of the stay required by the Rules.

Where stay tubes are screwed into tube plates and expanded $C = 52$. If they are fitted with nuts $C = 72$.

Where the plates are exposed to flame and the stays are screwed into the plate and fitted with nuts on the outside $C = 75$. Where the plates are not exposed to flame $C = 86$.

Where the stays pass through the plates not exposed to flame and are fitted with nuts inside and outside $C = 96$, and where the plates are exposed to flame $C = 84$.

2. Where plates are stiffened by flanging, the inner radius of which is not greater than $2\frac{1}{2}$ times the thickness of the plate, for the support thus given $C = 110$ where the plates are not exposed to flame and $C = 96$ where they are exposed to flame. The pitch is to be reckoned from the commencement of the curvature.

3. For portions of plate where the stays are irregularly pitched d^2 is to be used instead of $a^2 + b^2$, d being the diameter of the largest circle which can be drawn passing through not less than three points of support, viz., the centres of stays or the commencement of the curvature of flanging whichever is applicable. In this case C is to be taken as the mean of the values appropriate for the points of support.

4. For the tops and sides of combustion chambers the distance between the rows of stays nearest to the back tube plate or the back plate respectively and the commencement of curvature of these plates at their flanges is not to be greater than a.

5. The stays of the combustion chambers are to be so placed that the seams of the plates can be caulked without removing the stay nuts.

6. For the tops of combustion chambers where they are joined to the sides by curved portions, if the outer radius of the curved portion is less than half the allowable distance between the girders, the distance between the first girder and the inner surface of the side plate is not to exceed the allowable distance between the girders. If the radius of the curved portion is greater than half the allowable distance between the girders, the width of the flat portion measured from the centre of the girder is not to be more than half the allowable distance between the girders.

7. Where portions of plate are supported by stays secured in different ways the value of C to be taken is the mean of the values appropriate to the method of securing the supporting stays.

8. Where the plates are supported by stays passing through them and are fitted with nuts inside and washers and nuts outside, the diameter of the washers being at least 3·5 times that of the stay, and their thickness at least two-thirds of that of the plate but not greater than that of the plate :—

$$WP = \frac{100}{a^2 + b^2}[(t - 1)^2 + 0{\cdot}15\ t_w^2]$$

9. Where the washers have a diameter of at least two-thirds of the pitch of the stays and a thickness of at least two-thirds of the thickness of the plate but not greater than that of the plate and are riveted to the plate in an efficient manner :—

$$WP = \frac{100}{a^2 + b^2}[(t - 1)^2 + 0{\cdot}35\ t_w^2]$$

10. Where the plate is stiffened by strips at least two-thirds of the pitch of the stays in breadth and having a thickness at least two-thirds of that of the plate but not greater than that of the plate and are riveted to the plate in an efficient manner :—

$$WP = \frac{100}{a^2 + b^2}[(t - 1)^2 + 0{\cdot}55\ t_w^2]$$

11. Where the plates are fitted with doubling plates having a thickness of at least two-thirds of that of the plate but not greater than that of the plate and are riveted to them :—

$$WP = \frac{100}{a^2 + b^2}[(t - 1)^2 + 0{\cdot}85\ t_w^2]$$

12. For the portions of tube plates in the nests of tubes :—

$$WP = \frac{C\ (t - 1)^2}{p^2}$$

where t is the thickness of the tube plate in 32nds of an inch,

p is the mean pitch in inches of the stay tubes supporting any portions of the plate (being the sum of the four sides of the quadrilateral divided by 4),

$C = 38$ where the stay tubes are screwed and expanded into the plate and nuts are not fitted,

$C = 49$ where the stay tubes are screwed and expanded into the plates and fitted with nuts.

13. For the wide water spaces of front tube plates between the nests of tubes and between the wing rows of tubes and the shell :—

$$WP = \frac{C[(t-1)^2 + 0{\cdot}55t_w^2]}{a^2 + b^2}$$

where t is the thickness of the front tube plate in 32nds of an inch,

t_w is the thickness of the doubling plate, where so fitted in 32nds of an inch,

a is the horizontal pitch of stay tubes in inches measured across the wide water space,

b is the vertical pitch of stay tubes in the bounding rows, in inches, measured from centre to centre,

C = 52 where the stay tubes are screwed and expanded into the tube plate and nuts are not fitted,

C = 72 where the stay tubes are screwed and expanded into the tube plates, and nuts are fitted to each stay tube,

C = 63 where the stay tubes are screwed and expanded into the tube plates, and nuts are fitted only to alternate stay tubes.

14. If steel of less strength than 26 tons per square inch is used for flat plates, the working pressure allowed is to be correspondingly reduced.

Tube Plates under Compression.

Section 27. The pressure to be allowed on tube plates is to be calculated by the following formula, in which the compressive stress is taken at 14,000 lb. per square inch :—

$$WP = 875 \times \frac{(D - d) \times t}{W \times D}$$

where t is the thickness of the tube plate in 32nds of an inch,

D is the horizontal distance apart of the tubes centre to centre in inches,

d is the internal diameter of the plain tubes in inches,

W is the width of combustion chamber in inches measured inside from tube plate to back chamber plate, or between tube plates in double-ended boilers with combustion chambers common to two opposite furnaces.

Tube Plates of Vertical Boilers.

Section 28. Where vertical boilers have a nest or nests of horizontal tubes so that there is direct tension on the tube plates due to the vertical load on the boiler ends or to their acting as horizontal ties across the shell, the thickness of the tube plates and the spacing of the tubes are to be such that the section of metal taking the load is sufficient to keep the stress within that allowed on the shell plates.

Further, each alternate tube in the outer vertical rows of tubes is to be a stay tube. The tube plates between the stay tubes are to be in accordance with the rules for tube plates as in **Section 23, clause 12**, and in addition

$$WP = \frac{(t - 2) \times S \times (p - d) \times 100}{2{\cdot}9 \times D \times p}$$

where S is the minimum tensile strength of the steel plate in tons per square inch,

t is the thickness of the tube plate in 32nds of an inch,

D is twice the radial distance of the centre of the outer row of tube holes from the axis of the shell in inches,

p is the vertical pitch of tubes in inches,

d is the diameter of the tube holes in inches.

Girders.

Section 29. For girders supporting the tops of combustion chambers the following formula is to be used :—

$$WP = \frac{C \times d^2 \times t}{(L - P) \times D \times L} \times \frac{S}{28}$$

where d is the depth of the girder at centres in inches ;

t is the thickness of the girder at centre, where this is a forging, or the sum of the thicknesses of the plates where the girder is made of two plates, measured in 32nds of an inch ;

L is the length of the girder in inches, measured between the tube plate and back chamber plate inside, or between tube plates in chambers common to two opposite furnaces ;

P is the pitch of stays supported by the girder, in inches ;

D is the distance apart of the girders, centre to centre, in inches ;

S is the minimum tensile strength of the steel plates forming the girder, in tons per square inch. In the case of forged girders S is to be taken as 24 for iron and 28 for steel ;

C is a coefficient as follows :—

$$C = \frac{n}{n + 1} \times 495,$$

where the number of stays in each girder is odd,

$$= \frac{n + 1}{n + 2} \times 495,$$

where the number of stays in each girder is even, n being the number of stays to each girder.

STAYS.

Section 30. 1. For screw stays with threads not coarser than 9 threads per inch, made of steel or of special wrought iron tested to the requirements of the Rules (*see* Section 8 of the **Rules for the Quality and Testing of Materials**), the following formula is to be used, but in no case is the stress to exceed 9,000 lb. per square inch :—

$$WP = \frac{(d - 0{\cdot}267)^2 \times 8250}{a}$$

where d is the diameter of the stay over the thread in inches,

a is the area in square inches supported by one stay.

2. For steel longitudinal stays with threads not coarser than 6 threads per inch the working pressure is to be calculated from the following formula, but in no case is the stress to exceed 11,000 lb. per square inch where steel of a minimum tensile strength of 28 tons per square inch is used :—

$$WP = \frac{(d - 0{\cdot}340)^2 \times 9500}{a} \times \frac{S}{28}$$

where d is the diameter of the stay over the thread in inches,

a is the area in square inches supported by one stay,

S is the minimum tensile strength of the steel in tons per square inch.

3. In cases where longitudinal stays are made with enlarged ends and the body of the stay is smaller in diameter than at the bottom of the thread, and in cases where coarser threads than 6 per inch are used the working pressure is to be calculated from the following formula :—

$$WP = \frac{(d^1 - 0{\cdot}125)^2 \times 9500}{a} \times \frac{S}{28}$$

where d^1 is the diameter of the stay at the bottom of the thread or at the smallest part of the body.

BOILER TUBES, PLAIN AND STAY.

Section 31. 1. Where smoke tubes are made of steel, the material is to comply with the requirements of **Section 16** of the **Rules for Quality and Testing of Materials.**

2. (*a*) The tolerance in thickness shall be 10 per cent below and 10 per cent above the specified thickness.

(*b*) The external diameter of the tubes, measured at any point, shall be within the following tolerances of the diameter ordered.

For tubes under $2\frac{1}{2}$ inches outside diameter :—

$+ \frac{1}{64}$ inch.

$- \frac{1}{32}$ inch.

For tubes $2\frac{1}{2}$ inches outside diameter and larger :—

$\pm$ 1 per cent.

3. The following Table gives the working pressures permissible with plain boiler tubes of standard thicknesses, whether of lapwelded wrought iron or of lapwelded or seamless mild steel :—

Outside Diameter of tube in inches.	Standard thicknesses in L. S. G.				Working pressures in lb. per sq. inch.			
	A	B	C	D	A	B	C	D
2		11	10	9		155	215	300
$2\frac{1}{4}$	11	10	9	8	140	190	260	315
$2\frac{1}{2}$	11	10	9	8	125	175	230	300
$2\frac{3}{4}$	11	10	9	8	110	160	215	275
3	10	9	8	7	140	190	250	300
$3\frac{1}{4}$	10	9	8	7	130	180	230	280
$3\frac{1}{2}$	10	9	8	7	120	165	215	260

4. On stay tubes, whether of wrought iron or of steel, a working stress of 7,500 lb. per square inch of the net sectional area at the bottom of the thread is allowed.

5. The minimum thickness of stay tubes measured under the threads is to be $\frac{1}{4}$ inch for marginal stay tubes and $\frac{3}{16}$ inch for other stay tubes.

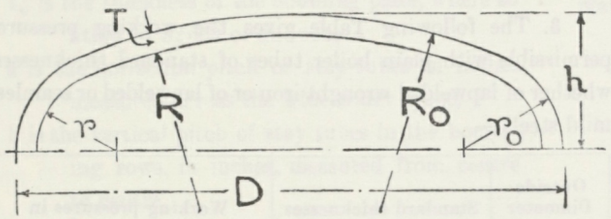
6. Stay tubes are to be screwed at both ends with continuous threads, and the holes in the tube plates are to be tapped with continuous threads. The pitch of the thread is not to be finer than 10 threads per inch. It is desirable however that they should be screwed to the standard 9 threads per inch. The stay tubes are to be expanded by roller expanders and not made tight by caulking only.

7. Nuts are not to be fitted to stay tubes at the combustion chamber end.

8. If stay tubes are increased in thickness at the screwed ends so that the thickness at the bottom of thread is practically the same as in the body of the tube, the thickening is to be attained by upsetting and not by any welding process, and the tubes are to be annealed after the upsetting.

Dished Plates without Stays.

Section 32. 1. For ends of boiler drums and receivers, crowns of vertical boilers and other similar plates dished to partial spherical form subject to pressure on the concave side, but not exposed to flame, and having no unreinforced opening greater than four times the thickness of the plate, the required thickness of plate is to be determined by formula (*a*) or (*b*).



$$(a)\ WP = \frac{4726 \times S \times h}{D^2} \left\{ \frac{\frac{r}{R} + 0{\cdot}05}{\frac{r}{R} + 0{\cdot}15} \right\} \times (T - 0{\cdot}03)$$

$$(b)\ WP = \frac{480 \times S(T - 0{\cdot}03)}{R}$$

where T = thickness of the end in inches after dishing, but in no case to be less than the thickness of a seamless unpierced shell of the same diameter and material.

WP = working pressure in lb. per square inch.

S = minimum tensile strength of the material in tons per square inch.

D = outside diameter of drum end in inches.

R = inside radius of curvature of end in inches which is not to exceed D.

r = inside corner radius in inches.

h = external height of dishing in inches measured from the centre of the inside corner radius and may be determined as follows:—

$$h = R_o - \sqrt{\left(R_o - \frac{D}{2}\right)\left(R_o + \frac{D}{2} - 2r_o\right)}$$

where R_o = outside radius of curvature of the end in inches.

r_o = outside corner radius in inches.

The inside corner radius "r" is not to be less than four times the thickness of the end plate and in no case less than 2·5 inches.

2. Proposals to make dished end plates of semi-elliptic form will be considered provided full details are submitted before the work is commenced.

3. Where the end is provided with a flanged manhole the thickness of the end in inches obtained by the foregoing formulae is to be increased by $\frac{1}{8}$ inch and the depth of the manhole flange, measured in inches from the outer surface at the minor axis shall be not less than

$$F = \sqrt{T_1 \times W}$$

where T_1 = the required thickness of the end plate in inches.

W = the minor axis of the manhole in inches.

4. Where the end is provided with large openings for branches, mountings, or unflanged manholes the thickness of the end as determined by the foregoing formulae, shall be increased by $\frac{1}{8}$ inch and adequate compensation shall be provided, at least equivalent to the cross sectional area obtained by multiplying the diameter or major axis of the opening cut in the end plate by the thickness required for an equivalent unpierced end.

5. Where the end is provided with small openings greater than four times the thickness of the end plate, local compensation is to be provided.

6. Where the end or crown is a complete hemisphere without stays or other supports, and is made in more than one plate, the working pressure to be allowed is given by the following formula:—

$$WP = \frac{(t - 2)\,S \times J}{C \times R}$$

where t is the thickness of the plates in 32nds of an inch,

S is the minimum tensile strength of the steel plates in tons per square inch,

J is the strength of riveted joint per cent of the solid plate,

R is the inner radius of curvature, in inches,

C is a coefficient which for treble riveting is 2·83, for double riveting is 2·9, and for single riveting is 3·3.

WATER TUBE BOILERS.

Section 33. 1. **General.**—Water tube boilers are, as regards construction, and the quality and tests of the material used in their construction, to comply with the general **Rules for Cylindrical Boilers**, except as hereinafter specified; and they are to be so designed as to ensure water circulation over every part of surfaces exposed to flame when working under service conditions.

2. **Welded Drums.**—Where the joints in the drums of boilers are made by means of welding, the drums are to be constructed in accordance with the **Rules for Welded Pressure Vessels.**

3. **Seamless Drums.**—Where seamless steel drums are used, the drums are to be made in accordance with **Section 10A** of the **Rules for the Quality and Testing of Materials.**

4. **Water Gauges.**—The position of the glass water gauges of boilers in which the tubes are entirely drowned when cold is to be such that water is just showing in the glass when the water level in the steam drum is just above the top of the uppermost tubes when the boiler is cold. In boilers, the tubes of which are not entirely drowned when cold, the glass water gauges are to be placed, to the Surveyor's satisfaction, in the positions which have been found by experience to indicate satisfactorily that the water content is sufficient for safety when the boiler is worked under all service conditions.

5. **Longitudinal Joints.**—The longitudinal joints of the cylindrical drums of water tube boilers, the internal diameters of which are less than 100 times the thickness of the plating at the joints, are not to be of ordinary riveted lapped type, but are to be such as to maintain internal circularity of section.

6. **Inclination of Water Tubes.**—The tubes which connect the drums or headers, and are the means for circulating the water when generating steam, are to be set at an inclination of not less than 15 degrees from the horizontal, but in the case of boilers where each tube is in series with one or more tubes so as to form a continuous run, the inclination need not exceed 5 degrees.

7. **Deposit Receptacles.**—It is desirable that provision should be made in the design so that solid matter in the water can be deposited automatically without danger arising from such matter collecting on parts exposed to heat.

8. **Protection of Steam Drum.**—Where the bottom of the steam drum is exposed to radiation from the fire, or to the impact of hot gases, and it is not protected by the tubes, a shield of good refractory material whose conductivity is low is to be fitted, or the tube plate is to be suitably thinned at this part.

Construction of Water Tube Boilers.

Section 34. 1. **Tube Ends.**—All tubes are to be carefully drifted or roller expanded in the holes in the tube plates. They are to project through the neck or bearing part in the holes by at least a $\frac{1}{4}$ inch. They are to be secured from drawing out at each end, and if this is done by bellmouthing only, the bellmouthing is to be $\frac{1}{32}$ inch for each inch in external diameter plus $\frac{2}{32}$ inch. That is, the increase of diameter at the outer end of the bellmouth for a tube of 1 inch in diameter is to be $\frac{3}{32}$ inch, for a 2 inch tube $\frac{4}{32}$ inch, and for a 3 inch tube $\frac{5}{32}$ inch.

2. **Tube Holes.**—(*a*) The tube holes in the tube plates of drums, pockets or headers are to be formed in such a way that the tubes can be effectively tightened in them. Where the tube ends are not normal to the tube plates, there is to be a neck or belt of parallel seating of at least $\frac{1}{2}$ inch in depth measured in a plane through the axis of the tube at the holes.

(*b*) Where the tubes are practically normal to their plates, this parallel seating is not to be less than $\frac{3}{8}$ inch in depth.

3. **Thinning of Tube Plates.**—Where the tube plates are reduced in thickness for the purpose of jointing either by lapping or by the fitting of butt straps, or in order to receive the drum end flanges, such reductions are to be gradual and carefully machined to size.

4. **Thickness of Tubes.**—(*a*) For pressures up to 250 lb. per square inch, the minimum thickness of tubes is to be calculated by the following formulæ :—

For the two rows of tubes next the fire and round the gaps formed in the nests of tubes for the outflow of the hot gases from the fire :—

$$t = \frac{WP \times d}{55} + 7$$

For all other tubes, including superheater tubes :—

$$t = \frac{WP \times d}{75} + 7$$

(*b*) For pressures above 250 lb. up to 650 lb. per square inch, and a designed steam temperature not exceeding 750° F., the minimum thickness of the tubes is to be calculated by the following formulæ :—

For the two rows of tubes next the fire and round the gaps formed in the nests of tubes for the outflow of the hot gases from the fire :—

$$t = \frac{d}{200}(WP + 400) + 9$$

For all other tubes, including superheater tubes :—

$$t = \frac{d}{200}(WP + 400) + 6$$

where WP is the working pressure in lb. per square inch,
d is the external diameter in inches,
t is the thickness in 100ths of an inch.

The maximum thickness of any tube is not to exceed 1 S.W.G. (0·3 inch).

5. **Tube Plates.**—Where tube plates form portions of cylindrical drums, their thickness in way of the tube holes is to be calculated by the following formula :—

$$t = \frac{WP \times C \times D}{S \times J} + 4$$

$$\text{or } WP = \frac{(t - 4)\, S \times J}{C \times D}$$

where D is the internal diameter of the drum in inches
t is the thickness of tube plates in 32nds of an inch,

S is the minimum tensile strength of the plate forming the drum in tons per square inch,

J is the percentage strength of the plate through the tube holes, viz. :— $\frac{p-d}{p} \times 100$,

p is the pitch of the tubes in inches on lines parallel with the axis of the drum,

d is the diameter of the tube holes in inches,

C = 3.

6. **Seamless Drums.**—For seamless steel drums the maximum working pressure to be allowed for the cylindrical shell clear of the tube holes is to be determined by the following formula :—

$$WP = \frac{35 \times S \times (t-2)}{D}$$

where WP = the working pressure in lb. per square inch.

S = the minimum tensile strength of the material in tons per square inch.

t = the thickness of the shell in 32nds of an inch.

D = the internal diameter of the cylindrical shell in inches.

7. **Headers and Analogous Fittings.**—These may be of wrought or cast steel, or of such other material as may be approved. If wrought steel is used, the material is to comply with the **Rules for the Quality and Testing of Materials.** If cast steel is used, the material is to comply with the aforementioned rules, or, alternatively, with the British Engineering Standards Specification for Grade C Cast Steel, which prescribes an elongation of not less than 15 per cent, measured on the Standard test piece, and a bend test through 90 degrees, without fracture of the test piece, the internal radius of the bend being not greater than 1 inch.

8. **Flat Surfaces of Headers and Similar Parts.**—(*a*) Where flat surfaces of headers or similar parts are not pierced for tubes, the thickness of such parts is not to be less than that given by the following formula :—

$$t = b \times \sqrt{\frac{WP}{C}} + 3$$

$$\text{or } WP = \left(\frac{t-3}{b}\right)^2 \times C$$

where t is the thickness in 32nds of an inch,

b is the breadth (in inches) of the flat surface measured from support to support inside,

C = 81 for wrought steel,

C = 64 for steel castings.

(*b*) The thickness of the headers at the tube holes in 32nds of an inch is not to be less than

$$t = 3 \times \sqrt{d} + 8$$

where d is the diameter of the hole in inches.

(*c*) The headers in way of the sighting doors are to be machined to give true and fair faces for the doors to joint upon. The thickness where machined may be as much as $\frac{3}{32}$ inch less than given by the above rule, but generally it is not to be less than $\frac{10}{32}$ inch.

(*d*) The thickness of all headers which are exposed to radiation from the fire, or to the impact of hot gases, and which have only steam within them under service conditions, as is the case with superheaters, is to be 12·5 per cent greater than that given by the above formula.

(*e*) The sighting hole doors are to be substantial, and capable of being removed and replaced from time to time without loss of efficiency or safety. Where they are held in place by bolts, the doors are to be so designed that they will not blow out in the case of the breakage of the bolt or otherwise.

(*f*) Every flange is to have a fillet with a radius not less than the thickness of the neck to which it is attached.

Boiler Mountings and Fittings for Water Tube Boilers.

Section 35. 1. **Safety Valves.**—(*a*) The safety valves are to be in number, area, design and ordinary construction, in agreement with **Section 22** of the **Rules for Cylindrical Boilers.**

(*b*) An approved type of safety valve of equally good and reliable design may be fitted in lieu of those described in the Rules.

2. **Waste Steam Pipe.**—The waste steam pipe and passages leading to it from the safety valves are to be in area of cross section not less than 1·1 times the combined area of the valves as given by the above formula.

3. **Accumulation Tests.**—Tests for accumulation of pressure are to be carried out with the stop valve closed and under full firing conditions for as long a time as the water supply in the boiler permits, but in no case need they exceed 7 minutes in duration. The accumulation is not to exceed 10 per cent of the working pressure.

4. **Stop Valves.**—Where two or more boilers are connected together, stop valves of self-closing or non-return types are to be fitted.

5. **Water Gauges.**—There are to be at least two water gauges to each boiler, fitted in such a way as to be quite independent of each other. One of them is to be a glass water gauge, while the other may be an equivalent; but where water and steam drums exceeding 13 feet in length are fitted athwartship a glass water gauge is to be fitted at or near each end of the drum.

6. **Feed Water Fittings.**—(*a*) Each boiler is to be fitted with at least two distinct and independent feed systems, each with its own check valve attached direct to the boiler. At least one of these systems is to be fitted with an approved apparatus whereby the supply is controlled automatically.

(*b*) The feed check valves are to be fitted with efficient gearing, whereby they can be satisfactorily worked from the stokehold floor, or other convenient position.

7. **Manholes.**—In all the drums, manholes are to be provided of such size as to permit of access for internal examination, and for the satisfactory fitting of all the tubes in place.

8. **Mountings and Fittings.**—Those not referred to in this Section are to be in accordance with **Sections 19, 20, 21 and 23**, of the **Rules for Cylindrical Boilers.**

Tubes for Water Tube Boilers.

Section 36. 1.—All tubes subject to internal pressure are to be solid drawn and made of steel produced by an open-hearth process, acid or basic, the ultimate tensile strength of which does not exceed 28 tons per square inch, and the elongation of which is not to be less than 30 per cent on a Standard Test Piece C (British Standards Institution Test Piece F), when in the billet or bar form, and is to be certified as such by the makers of the steel and of the tubes.

2. All tubes under $1\frac{1}{2}$ inches external diameter are to be cold finished; these, and all other cold-drawn tubes, are to be satisfactorily annealed before examination.

3. All tubes are to be free from defects, both within and without.

Tests of Tubes for Water Tube Boilers.

Section 37. 1.—All tubes up to 10 L.S.G. in thickness are to be capable of being flattened by hammering when cold until the inner surfaces are not further apart than $\frac{2}{32}$ inch. For those over 10 L.S.G., and not exceeding 6 L.S.G., the maximum distance apart is to be $\frac{7}{32}$ inch; for those over 6 L.S.G., and not exceeding 3 L.S.G., the maximum distance apart is to be $\frac{12}{32}$ inch; and for those whose thickness exceeds 3 L.S.G., the maximum is to be $\frac{18}{32}$ inch. In all cases after undergoing such tests there are not to be any signs of cracking or other fracture.

2. All tubes when cold are to be able to withstand, without cracking, an enlargement of diameter at both ends by means of roller expanders, or by drifts to the extent of:—

Thickness of Tubes.	Enlargement of Diameters at Ends by means of	
	Roller Expanders.	Drifts.
Up to 10 L.S.G.	12·5 per cent	9·5 per cent
Above 10 L.S.G. & up to 6 L.S.G.	9·5 per cent	7·0 per cent
Above 6 L.S.G.	6·5 per cent	5·5 per cent

3. (*a*) Tubes should be presented for test in batches of 100 each. Two tubes are to be selected indiscriminately from each of at least two batches, and one from each of any remaining batches. Each tube so selected is to be subjected to the above expanding tests, and one tube from each batch, which may be a tube that has sustained the expansion test, is also to be flattened cold to the extent specified in **clause 1** at three different parts of its length, of which one position is to be at or near the middle of the tube, and the flattened portions are to be in three different planes. The tubes are to pass these tests without signs of cracking.

(*b*) Should one of the selected tubes fail to withstand either of these tests, two further tubes are to be selected from the batch and be subjected to both the prescribed tests. If further failure occurs the particular batch of tubes is to be rejected as unsatisfactory.

4. (*a*) Every tube is to be tested at the Tube Maker's Works by hydraulic pressure to not less than 1,000 lb. per square inch.

(*b*) Downcomer tubes are to be tested as required for steam pipes.

5. The manufacturer's certificate of the results of the foregoing tests may, at the discretion of the Surveyor, be accepted provided each tube is delivered with 1 inch in excess of the finished length, which excess is to be partly severed for flattening to the extent prescribed in **clause 1.**

6. Every tube delivered is to be straight (unless otherwise specified) and is to be practically concentric throughout its length. The tolerance or deviation from the specified thickness is to be within the following limits:—

(*a*) **Cold Finished Tubes.**—The tolerance in thickness shall be 5 per cent below and 10 per cent above the specified thickness.

(*b*) **Hot Finished Tubes.**—The thickness of the tubes shall be within the following tolerances, measured at any point :—

From $1\frac{1}{2}$ inches up to and including $2\frac{1}{2}$ inches...	$-7\frac{1}{2}$ per cent. $+17\frac{1}{2}$ „ „
Over $2\frac{1}{2}$ inches up to and including $4\frac{1}{2}$ inches...	-5 per cent. $+15$ „ „
Over $4\frac{1}{2}$ inches	$-7\frac{1}{2}$ per cent. $+17\frac{1}{2}$ „ „

The tolerances in external diameter from those specified are to be as follows :—

(*a*) **Cold Finished Tubes.**—The external diameter of the tubes, measured at any point, shall be not greater than that specified, but may be less by a maximum of 1 per cent.

(*b*) **Hot Finished Tubes.**—The external diameter of the tubes, measured at any point, shall be within the following tolerances of the diameter ordered :—

For tubes from $1\frac{1}{2}$ inches but below $2\frac{1}{2}$ inches...	$+\frac{1}{64}$ inch. $-\frac{1}{32}$ „
For tubes $2\frac{1}{2}$ inches diameter and over...	± 1 per cent.

Spare Gear.

Section 38. In vessels engaged on ocean going service and fitted with Steam Reciprocating Engines the articles mentioned in the following list (so far as they are applicable) will be required to be carried, viz. :—

*For a single-screw ship a propeller, or two blades with studs and nuts for one blade. The propeller or blades may be of cast iron, except for ships having the notation "Strengthened for Navigation in Ice."

1 complete bottom end bearing.

1 complete top end bearing.

*1 set of metallic packing complete for each size of main piston rod.

*1 set of coupling bolts of each size used.

1 set of pads of each hand for one face of Michell thrust block.

1 set of feed and bilge pump valves and seats where these pumps are worked by the main engines.

1 set of valves of each size used for the liquid end of each independent pump.

1 set of air pump valves.

1 set of circulating pump valves.

1 valve lid for main feed check for one boiler.

*1 impeller shaft for main circulating pump.

1 set of rings for H.P. piston.

1 set of rings for H.P. piston valve.

1 valve of each size with springs and rollers where poppet valves are used on the main engines.

12 boiler tube stoppers complete.

A set of fire bars for one furnace.

1 set of oil fuel burner nozzles complete with atomisers, etc., for one boiler.

A quantity of assorted bolts, studs and nuts. Steel bars and plates of various sizes.

Spare Gear for Steam Turbine Engines.

In vessels engaged on ocean going service and fitted with Steam Turbine Engines the articles mentioned in the following list (so far as they are applicable) will be required to be carried, viz. :—

*For a single screw ship a propeller, or two blades with studs and nuts for one blade. The propeller or blades may be of cast iron, except for ships having the notation "Strengthened for Navigation in Ice."

1 set of coupling bolts of each size used.

*1 complete bearing bush of each size used for main gear wheel shaft.

1 complete bearing bush of each size used for rotor shaft.

1 complete bearing bush of each size used for pinion shaft.

1 half set of packing rings or segments for each gland of rotor shafts so fitted, and half the number of springs fitted.

2 ordinary thrust shoes for main thrust block or sufficient pads for one face of Michell type of main thrust block of each hand.

Turbine thrust and adjusting bushes with rings complete (or one set of pads of each hand for Micnell type) for one turbine of each size fitted.

1 set of liners for adjusting block of different thicknesses.

1 set of valves of each size used for the liquid end of each pump.

1 valve lid for main feed check for one boiler.

*1 impeller shaft for main circulating pump.

12 boiler tube stoppers complete.

1 set of fire bars for one furnace.

1 set of oil fuel burner nozzles complete with atomisers, etc., for one boiler.

A quantity of assorted studs, bolts and nuts. Steel bars and plates of various sizes.

*Not required for vessels engaged on short voyages.

PERIODICAL SURVEYS.

Section 39. The periodical surveys of the machinery and boilers are detailed on pages 23–27 under **Periodical Special Surveys of Main and Auxiliary Engines and Boilers and Electrical Equipment.**

71, Fenchurch Street, London, E.C. 3
17th October, 1946.

REDUCTION GEARING
INTENDED FOR
MAIN PROPELLING MACHINERY
AND FOR
AUXILIARY ELECTRICAL GENERATING
MACHINERY

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REDUCTION GEARING INTENDED FOR MAIN PROPELLING MACHINERY AND FOR AUXILIARY ELECTRICAL GENERATING MACHINERY

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REQUIREMENTS FOR REDUCTION GEARING INTENDED FOR MAIN PROPELLING MACHINERY.

Section 1. 1. General.—The following requirements are applicable to all cases of reduction gearing for propelling purposes where more than 500 shaft horse-power is transmitted to the intermediate shaft.

2. Plans of gearing are to be submitted for approval together with the following particulars, viz. :—

Shaft horse-power and revolutions for each pinion,
Number of teeth in each gear,
Pitch circle diameters,
Helix angle,
Normal pitch of teeth,
Addendum,
Dedendum,
Type of tooth profile,
Face widths,
Pressure angle of teeth (normal or transverse).

In addition, arrangement plans are to be submitted for approval.

3. In the case of welded construction, full details of the welding and welding procedure are to be indicated. Gear wheels and gear cases of welded construction are to be suitably stress-relieved, particulars of which are to be submitted.

4. Gear Loads.—Gear loads for maximum designed shaft horse-power are not to exceed those given by the following formula, viz. :—

$$P = K \times d \times \frac{R}{R+1}$$

where P = load in lb. per inch of overall face width, including chamfering and tapering of tooth ends.

K = 80, except in the case of double reduction gears having the secondary pinion solid with the primary wheel, where K is to be taken as 67.

d = pitch circle diameter of the pinion in inches.

R = the gear ratio, pinion speed/gear wheel speed.

In cases where it is desired to use a higher value of P than that permitted by the above formula, the Committee will be prepared to give consideration to the circumstances of any special case.

5. Primary Pinion Bearings.—Where the total axial length in inches over the gear face and gap is greater than

$$d \times (3{\cdot}5 - \tfrac{1}{4}\sqrt{d})$$

where d is the pitch circle diameter of the pinion in inches.

a centre bearing is to be provided between the right and left-hand helices.

6. Dressing of the Ends of the Teeth.—The ends of the teeth are to be cut back at an angle of 45° to 60° to the pitch line and, in the case of pinions, are to be tapered on each tooth flank to an extent of at least 0·03 inch to nothing at a distance of $\frac{3}{8}$ inch measured parallel to the chamfered tooth end.

7. Balance of Gear Pinions and Wheels.—All primary pinions over 12 inches in diameter, complete with half claw couplings where fitted, are to be balanced dynamically.

All primary wheels, including those with secondary pinions, also main wheels, are to be balanced statically.

8. Alignment and Bedding of Gears.—The alignments of all wheel and pinion shafts, primary pinion drives from the turbines, main wheel and line shafting, also the bedding of the gears, are to be to the satisfaction of the Surveyors.

9. Torsional Vibration.—With engines situated aft full details of the torsional vibration characteristics of the dynamic system comprising propeller, line shafting, gearing and turbines are to be submitted for consideration.

MATERIALS.

Section 2. 1. The materials used for pinions, pinion sleeves and gear wheel rims are to comply with the following requirements:—

(*a*) The steel is to be made by the Acid Open Hearth or Electric processes.

(*b*) Ingots are to be cast in chilled moulds with the larger diameter or cross sections uppermost and with efficient refractory feeder heads.

Pinions.

2. Pinions are to be made from nickel steel.

The chemical composition is to be as follows:—

Carbon ...	0·24	to	0·35	per cent.
Nickel ...	3·25	to	3·75	per cent.
Sulphur ...	not to exceed		·035	per cent.
Phosphorus	not to exceed		·035	per cent.

In cases where it is desired to use alternative alloys, full details of the chemical composition, physical properties and heat treatment are to be submitted for the consideration of the Committee.

3. Manufacture of Forgings.—The forgings are to be gradually and uniformly forged from ingots from which at least 30 per cent. of the total weight of the ingot is to be removed from the top end of the ingot and at least 5 per cent. of the ingot from the bottom end.

The sectional area of any part of the forging (as forged) is not to exceed:—

(1) One third of the sectional area of the ingot where the length at any diameter is greater than its diameter.

(2) Two thirds of the sectional area of the ingot where the length at any diameter is less than its diameter, *e.g.*, "a collar".

Sleeves are to be hollow forged or hollow rolled. Full particulars should be submitted for the consideration of the Committee, indicating clearly in each case the amount of forging which will be done on the original ingot in obtaining the rough unmachined forging.

The forgings are to be made with sufficient material on the portion on which the teeth will be cut to allow not less than the following amounts being machined from surfaces of the finished forging before heat treatment, but leaving $\frac{1}{4}$ inch on all surfaces:—

(*a*) Large forgings for pinions 6 inches and over in diameter over the toothed portion when finished—one inch on diameters.

(*b*) Small forgings for pinions under 6 inches in diameter over the toothed portion when finished—$\frac{3}{4}$ inch on diameters.

4. Heat Treatment.—The forgings may be normalized and tempered or, alternatively, may be oil hardened and tempered. Details of the heat treatment given to the forgings are to be furnished.

5. Mechanical Properties of Forgings after Heat Treatment.—A sufficient length of forging is to be provided to admit of a longitudinal test piece being taken from each end of the shaft portion and a transverse test piece from each end of the body portion, or sleeve where fitted. Test pieces are to be of the specified dimensions.

The forgings after heat treatment are to have the following mechanical properties, viz.:—

Ultimate Tensile Strength (on standard test piece 2 inch × 0·564 inch diameter) to be not less than 40 tons per sq. inch, longitudinal and transverse.

Yield Point to be not less than 60 per cent. of the ultimate tensile strength, longitudinal and transverse.

Elongation to be not less than 23 per cent. in 2 inches longitudinal and 16 per cent. in 2 inches transverse.

Bend Test.—180° without fracture over $\frac{3}{4}$ inch radius, longitudinal and transverse. Dimensions of test piece $\frac{3}{4}$ inch × $\frac{3}{8}$ inch.

Impact Test.—Test specimens cut longitudinally 10 m.m. square with "V" notch 2 m.m. deep × 45°, with 0·25 m.m. radius at root, to give a value of not less than 35 ft. lb. in the case of oil-hardened and tempered steels and not less than 20 ft. lb. in the case of normalized and tempered steels.

6. **Brinell Tests.**—Brinell tests are to be taken on all forgings, after machining to $\frac{1}{4}$ inch over finish machined diameter after heat treatment. The impressions are to be taken at each end of two diameters at right angles in three different positions over each toothed portion of the pinion. The forging will be considered sufficiently uniform if there is not more divergence than 30 in Brinell number between any two readings.

7. **Sulphur Prints.**—Sulphur prints are to be taken, after rough machining, over the whole portion of the forging on which teeth are to be cut, and in addition from each end of the forging. The prints are to be submitted for consideration.

GEAR WHEEL RIMS.

8. **Manufacture of Forgings.**—The forgings are to be gradually and uniformly forged from ingots from which top and bottom discards, not less than required in the case of pinions, have been taken. Full particulars are to be submitted for the consideration of the Committee, indicating clearly in each case the amount of forging which will be done on the original ingot in obtaining the rough unmachined forging.

The forgings are to be made sufficiently long to allow transverse test pieces to be taken from each end of each forging.

9. **Heat Treatment.**—All rim forgings after completion are to be efficiently normalized.

10. **Mechanical Properties.**—The forgings after heat treatment are to have the following mechanical properties:—

(*a*) Ultimate Tensile Strength (on standard test piece 2 inch × 0·564 inch diameter cut circumferentially) to be between the limits of 31 to 35 tons per square inch, and the sum of the tensile breaking strength in tons per square inch and percentage elongation, measured on the standard test piece, is to be not less than 57.

(*b*) Bend Test.—180° without fracture over $\frac{3}{8}$ inch radius. Dimensions of test piece 1 inch square.

11. Gear wheel rims may be made of steel having a greater ultimate tensile strength than 35 tons per square inch, but in such cases full details of the mechanical properties should be submitted for approval.

12. In cases where separate rims are not used and the wheels are of solid forged construction, the mechanical properties of the material are to comply with **Section 2, clause 10**. Where, however, such wheels are of cast steel construction, full details of the chemical analysis, heat treatment and mechanical properties should be submitted for approval.

13. All forgings for pinions and wheel rims are to be sound and free from defects. Forgings may be rejected after the cutting of teeth, if defects are then revealed, notwithstanding acceptance during the earlier stages of manufacture.

14. Other steels used in the construction of gearing are to comply with the requirements of the **Rules for the Testing of Ingot Steel Forgings**, or for **Boiler Quality Steel Plates**, as the case may be.

71, Fenchurch Street, London, E.C.3.

11th March, 1946.

REQUIREMENTS FOR REDUCTION GEARING INTENDED FOR AUXILIARY ELECTRICAL GENERATING MACHINERY.

Section 1. 1. General.—The following requirements are applicable to all cases of reduction gearing used in the generation of electric power for essential auxiliary services.

2. Submission of Plans.—The requirements of Section 1, clause 2, of the Rules for Reduction Gearing intended for Main Propelling Machinery are to be complied with.

3. Welded Construction.—The requirements of Section 1, clause 3, of the Rules for Reduction Gearing intended for Main Propelling Machinery are to be complied with.

4. Gear Loads.—Gear loads are not to exceed those given by the following formula, viz. :—

$$P = K \times d \times \frac{R}{R+1}$$

where P = load in lb. per inch of overall face width, including chamfering and tapering of tooth ends.

K = 90 at normal full load rating and 112·5 based on 25 per cent. overload.

d = pitch circle diameter of pinion in inches.

R = the gear ratio, pinion speed/gear wheel speed.

5. Primary Pinion Bearings.—The requirements of Section 1, clause 5, of the Rules for Reduction Gearing intended for Main Propelling Machinery are to be complied with.

6. Dressing of the Ends of the Teeth.—The ends of the teeth are to be cut back at an angle of 45° to 60° to the pitch line, and in the case of pinions, may be tapered on each tooth flank to an extent of 0·02 inch to nothing at a distance of ¼ inch measured parallel to the chamfered tooth end.

7. Balance of Gear Wheels.—Gear wheels are to be either statically or dynamically balanced.

8. Alignment and Bedding of Gears.—The alignments of wheel and pinion shafts, also the bedding of the gears, are to be to the satisfaction of the Surveyors.

MATERIALS.

Section 2. The requirements of Section 2 of the Rules for Reduction Gearing intended for Main Propelling Machinery are to be complied with.

71, Fenchurch Street, London, E.C.3.
13th December, 1945.

WELDED PRESSURE VESSELS.

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RULES FOR WELDED PRESSURE VESSELS.

Note:—The following rules relate to welded pressure vessels of thickness not less than $\frac{3}{16}$ inch and operating at temperatures not exceeding 650° F. Vessels intended for higher temperatures than 650° F. may be constructed in accordance with these rules, with the exception that the scantlings and routine tests required will be subject to special consideration when the plans are submitted for approval.

Section 1. **1. Definitions.**—(*a*) The term "Fusion Weld" is, for the purposes of these rules, applicable to all welded joints made by the oxy-acetylene or the oxy-hydrogen process, the metal-arc process with covered electrodes, or other electric arc process in which the arc stream and the deposited weld metal are shielded from atmospheric contamination.

(*b*) The term "Forge Weld" is, for the purposes of these rules, applicable to joints made between plates which are welded together by means of hammering or rolling, and in which no added metal is included.

2. Quality of Material.—The material used in the construction of welded pressure vessels is to be in accordance with **Section 5** of the **Rules for the Quality and Testing of Materials.**

3. **Design.**—(*a*) In all cases, before construction is commenced, plans are to be submitted showing full details of the welding and giving particulars of the size and type of electrodes, also the ultimate tensile strength of the materials proposed to be used in the construction of the pressure vessel.

(*b*) In order to facilitate consideration when classifying pressure vessels, as per **Section 1, clause 4,** and especially in cases in which there may appear to be som doubt regarding the class under which a vessel may be considered, particulars of the service conditions for which the vessel is intended, should also be submitted.

(*c*) For the cylindrical shells of welded steel pressure vessels, the maximum working pressure to be allowed is to be calculated from the following formula :—

$$\mathbf{WP} = \frac{f\,(t-2)}{16 \times \mathbf{D}}$$

where **WP** = the working pressure in lb. per square inch.

f = the maximum permissible stress in the longitudinal joint in lb. per square inch, as given in Table 1 for Fusion Welded Pressure Vessels and Table 2 for Forge Welded Pressure Vessels.

t = the thickness of the shell plates in 32nds of an inch.

D = the internal diameter of the cylindrical shell in inches.

TABLE 1.

Maximum Permissible Stresses in the Longitudinal Joints of Fusion Welded Pressure Vessels, for Temperatures Not Exceeding 650° F.

Conditions in respect of Routine Tests and Heat Treatment.		Maximum Permissible Stress 'f' to be used in Formula given in Section 1, clause 3 (c).					
		Minimum Tensile Strength of Plate :— 26 tons per sq. in.			Minimum Tensile Strength of Plate :— 28 tons per sq. in.		
		Class 1. lb. per sq. in.	Class 2. lb. per sq. in.	Class 3. lb. per sq. in.	Class 1. lb. per sq. in.	Class 2. lb. per sq. in.	Class 3. lb. per sq.in.
Vessels made by approved manufacturers only and subject to routine tests prescribed in Section 2, clause 2, and including complete X-ray examination and heat treatment.	Unfired vessels.	12,900	—	—	13,900	—	—
	Fired vessels.	12,200	—	—	13,100	—	—
Subject to routine tests prescribed in Section 3, clause 2, and including heat treatment.		—	A. 11,500	—	—	A. 12,400	—
Subject to routine tests prescribed in Section 3, clause 2, but not including heat treatment.		—	B. 10,800	—	—	B. 11,600	—
Subject to routine tests prescribed in Section 4, clause 2, and including heat treatment.		—	—	A. 10,000	—	—	A. 10,800
Subject to routine tests prescribed in Section 4, clause 2, but not including heat treatment.		—	—	B. 9,300	—	—	B. 10,000
Subject to hydraulic test only.		—	—	C. 8,600	—	—	C. 9,300
Double fillet lap joint for longitudinal shell seams, for shell thickness not exceeding $\frac{3}{8}$ in. Subject to hydraulic test only.		—	—	D. 7,900	—	—	D. 8,500

NOTE: Where the minimum tensile strength of the plate material is other than 26 or 28 tons per sq. in., but not more than 35 tons per sq. in., the maximum permissible stress should be proportional to the above.

(d) Where tube plates form portions of cylindrical drums, their thickness in way of the tube holes is to be calculated by the following formula :—

$$t = \frac{WP \times C \times D}{S \times J} + 4$$

$$\text{or } WP = \frac{(t-4)\,S \times J}{C \times D}$$

where **D** is the internal diameter of the drum in inches

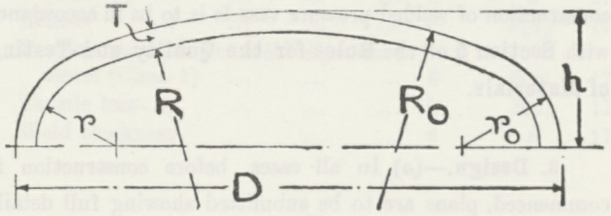
t is the thickness of tube plates, in 32nds of an inch.

S is the minimum tensile strength of the plate forming the drum, in tons per square inch.

J is the percentage strength of the plate through the tube holes, viz. :—$\frac{p-d}{p} \times 100$ where p is the pitch of the tubes in inches, on lines parallel with the axis of the drum and d is the diameter of the tube holes in inches,

$C = 3$.

(e) **Dished Plates without Stays.**—For ends of boiler drums and receivers, crowns of vertical boilers and other similar plates intended for Class 1 pressure vessels and dished to partial spherical form, subject to pressure on the concave side, but not exposed to flame, and having no unreinforced opening greater than four times the thickness of the plate, the required thickness of plate is to be determined by formula (a) or (b). For end plates of similar type intended for Class 2 or Class 3 Pressure Vessels, the required thickness may be determined by formula (c).



(a) $$WP = \frac{4726 \times S \times h}{D^2}\left\{\frac{\frac{r}{R}+0{\cdot}05}{\frac{r}{R}+0{\cdot}15}\right\} \times (T-0{\cdot}03)$$

(b) $$WP = \frac{480 \times S\,(T-0{\cdot}03)}{R}$$

(c) $$WP = \frac{576 \times S \times T}{R}$$ for Class 2 and Class 3 ONLY.

where T = thickness of the end in inches after dishing but in no case to be less than the thickness of a seamless unpierced shell of the same diameter and material.

WP = working pressure in lb. per square inch.

S = minimum tensile strength of the material in tons per square inch.

D = outside diameter of drum end in inches.

R = inside radius of curvature of end in inches, which is not to exceed D.

r = inside corner radius in inches.

h = external height of dishing in inches measured from the centre of the inside corner radius and may be determined as follows :—

$$h = R_o - \sqrt{\left(R_o - \frac{D}{2}\right)\left(R_o + \frac{D}{2} - 2r_o\right)}.$$

where R_o = outside radius of curvature of the end in inches.

r_o = outside corner radius in inches.

The inside corner radius "r" is not to be less than four times the thickness of the end plate and in no case less than 2·5 inches.

(*f*) Proposals to make dished end plates of semi-elliptic form will be considered provided full details are submitted before the work is commenced.

(*g*) Where the end plates are dished to partial spherical form, subject to pressure on the convex side and not fitted with stays, the following formula is to be used :—

$$WP = \frac{C \times T \times S}{R}$$

where T = the thickness of the end plate in inches.

R = the radius of the convex surface of the end plate in inches, which is not to exceed the diameter of the shell.

S = minimum tensile strength of the material in tons per square inch.

C = 310 for Class 1 Pressure Vessels when T does not exceed $\frac{3}{16}$ inch,

= 340 for Class 1 Pressure Vessels when T exceeds $\frac{9}{16}$ inch,

= 370 for Classes 2 and 3 Pressure Vessels when T does not exceed $\frac{9}{16}$ inch,

= 410 for Classes 2 and 3 Pressure Vessels when T exceeds $\frac{9}{16}$ inch.

(*h*) Where the end is provided with a flanged manhole the thickness of the end in inches obtained by the foregoing formulæ, is to be increased by $\frac{1}{8}$ inch, and the depth of the manhole flange, measured in inches from the outer surface at the minor axis is not to be less than

$$F = \sqrt{T_1 \times W}$$

where T_1 = the required thickness of the end plate in inches.

W = the minor axis of the manhole in inches.

(*j*) Where the end is provided with large openings for branches, mountings or unflanged manholes, the thickness of the end as determined by the foregoing formulæ shall be increased by $\frac{1}{8}$ inch and adequate compensation shall be provided, at least equivalent to the cross sectional area obtained by multiplying the diameter or major axis of the opening cut in the end plate by the thickness required for an equivalent unpierced end.

(*k*) Where the end is provided with small openings greater than four times the thickness of the end plate, local compensation is to be provided.

(*l*) For unstayed flat end plates welded to cylindrical shells either by forge welding or by one of the fusion welded methods shown in **Fig. 1,** (*See page* 162),

$$WP = \frac{C \times (t_1 - 1)^2}{D^2}$$

where WP = the working pressure in lb. per square inch.

t_1 = the thickness of the end plate in 32nds of an inch.

D = the internal diameter in inches.

C = 72·5 when end plate is exposed to flame.

= 100 when end plate is not exposed to flame.

(*m*) Where a flat plate is flanged to stiffen it at a manhole or sighthole, the total depth of the flange measured in inches from the outer surface is to be at least equal to $\sqrt{t \times w}$, where t is the thickness of the plate in inches and w is the minor axis of the hole in inches.

(*n*) Manholes in cylindrical shells are to have their shorter axes arranged longitudinally. Where the cylindrical shell is cut for a manhole, compensation is to be provided in accordance with **clause 3** (*n*).

(*o*) Compensation is to be provided for all openings in shell plates if the diameters of such openings exceed $2\frac{1}{2}$ times the thickness of the shell plus $2\frac{3}{4}$ inches.

The total area of compensation to be provided is not to be less than the sectional area of the plate cut out to form the opening multiplied by the ratio :—

$$\frac{\text{Permissible stress in welded joint in lb. per sq. in.}}{560 \times \text{min}^{\text{m}}\text{. tensile strength of shell plate in tons per sq. in.}}$$

The sectional area cut out is to be based on the thickness of a seamless shell and measured on the centre line of the opening parallel with the longitudinal axis of the shell, and the area of compensation provided is to be

measured in the same plane as the sectional area cut out, and may include the sectional area of the welds by which the compensating plate or branch piece may be attached.

In cases where branch pieces are welded to the shell or end plate, the maximum height of the branch body to be reckoned as compensating for the sectional area cut-out is to be obtained thus :—

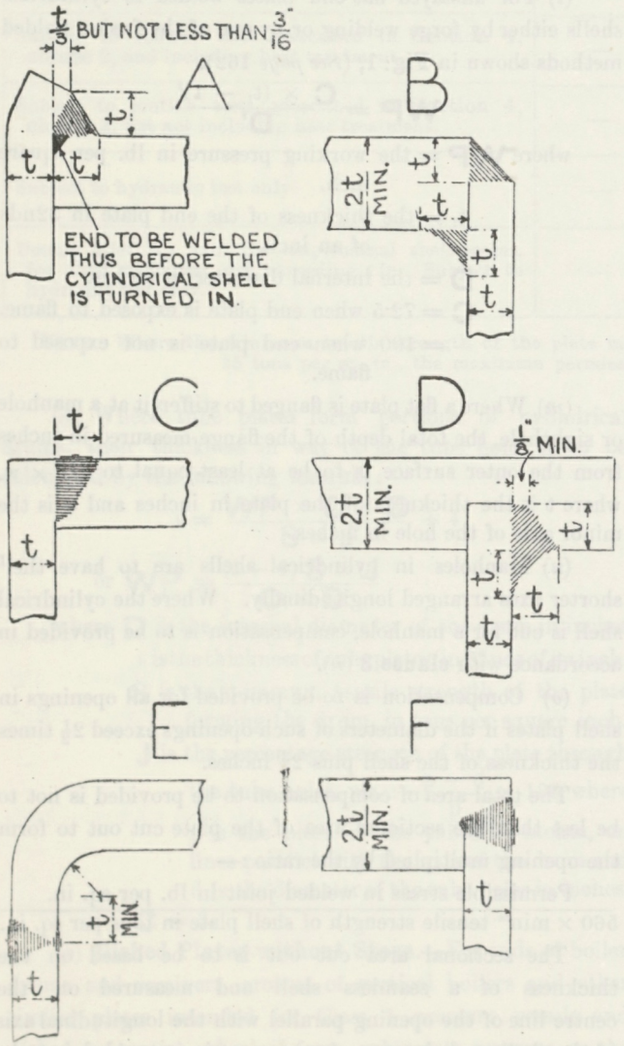
$$H = 1{\cdot}2\sqrt{D \times T}$$

where H = the height in inches measured from the inside surface of the shell or end plate,

D = the diameter or longitudinal axis, in inches of the opening cut in the plate,

T = the thickness in inches of the shell or end plate.

FIG. 1. TYPICAL ACCEPTABLE METHODS OF ATTACHING FLAT END PLATES TO CYLINDRICAL SHELLS.



NOTE :—The proportions indicated for the welds are minima only.

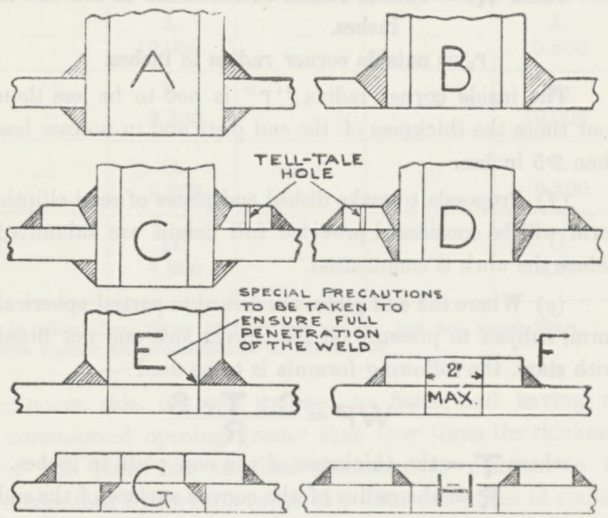
If the height of the branch obtained by the above formula, in conjunction with its thickness is inadequate to compensate for the sectional area cut-out, additional compensation is to be provided.

(*p*) All welded compensating plates, branch pieces and bosses may be secured by one of the methods shown in **Fig. 2.**

Compensating plates attached to the outside of a vessel as in Fig. 2 (C) and (D) are to be provided with a tell-tale hole not greater than $\frac{3}{8}$" diameter. The tell-tale hole is to be left open to the atmosphere.

In the case of compensating plates attached to the inside of a vessel the tell-tale hole is to be drilled in the shell.

FIG. 2. TYPICAL ACCEPTABLE METHODS OF ATTACHING BRANCHES, COMPENSATING RINGS AND BOSSES.



NOTE :—Type(E) should be used for the attachment of heavy branches to relatively thick shells.

Flanges may be attached to branch pieces by any of the methods shown in **Fig. 3.**

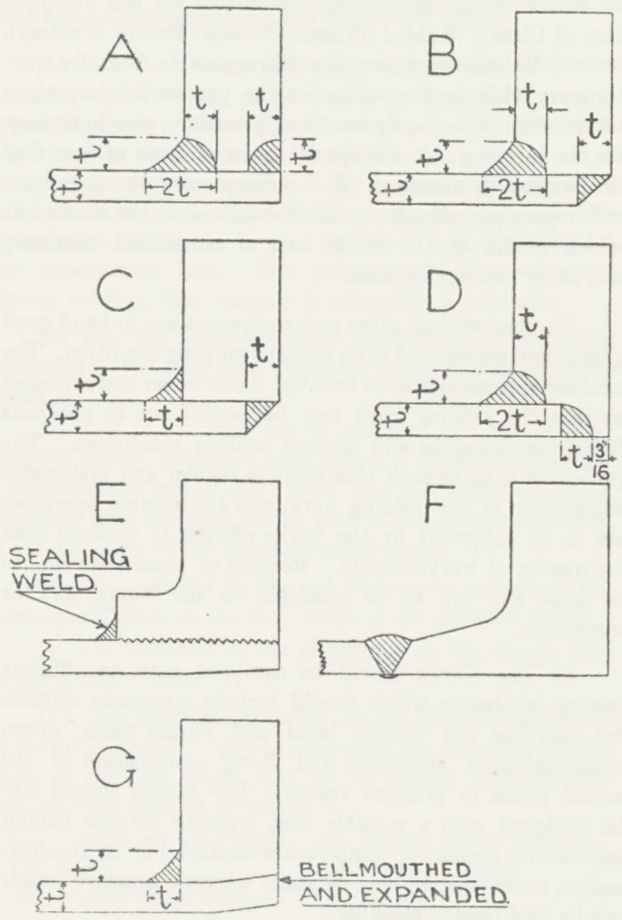
Alternative methods will be accepted if considered to be of equivalent strength.

Where flanges are secured by screwing, the branch and flange are to be screwed with a vanishing thread, and the diameter of the screwed portion of the branch over the thread must not be less than the outside diameter of the unscrewed branch.

After the flange has been screwed hard home the branch is to be expanded into the flange and may be provided with a sealing weld. (See type (E) Fig. 3.)

The vanishing thread on a branch is to be not less than three pitches in length and the diameter at the root of the thread is to increase uniformly from the standard root diameter to the diameter at the top of the thread. This may be produced by suitably grinding the dies, and the flange should be tapered out to the same formation.

FIG. 3. TYPICAL ACCEPTABLE METHODS OF SECURING FLANGES TO BRANCHES WHICH ARE DIRECTLY ATTACHED TO PRESSURE VESSELS.



NOTE:—The proportions indicated for the welds are minima only.

Types (A), (D) & (F).—Acceptable for all pressure and temperature conditions.

Type (B).—Acceptable for working pressures not exceeding 250 lb. per sq. in. and temperatures not exceeding 750° F.

Type (C).—Acceptable for working pressures not exceeding 100 lb. per sq. in.

Type (E).—Acceptable for working pressures not exceeding 450 lb. per sq. in. and temperatures not exceeding 750° F.

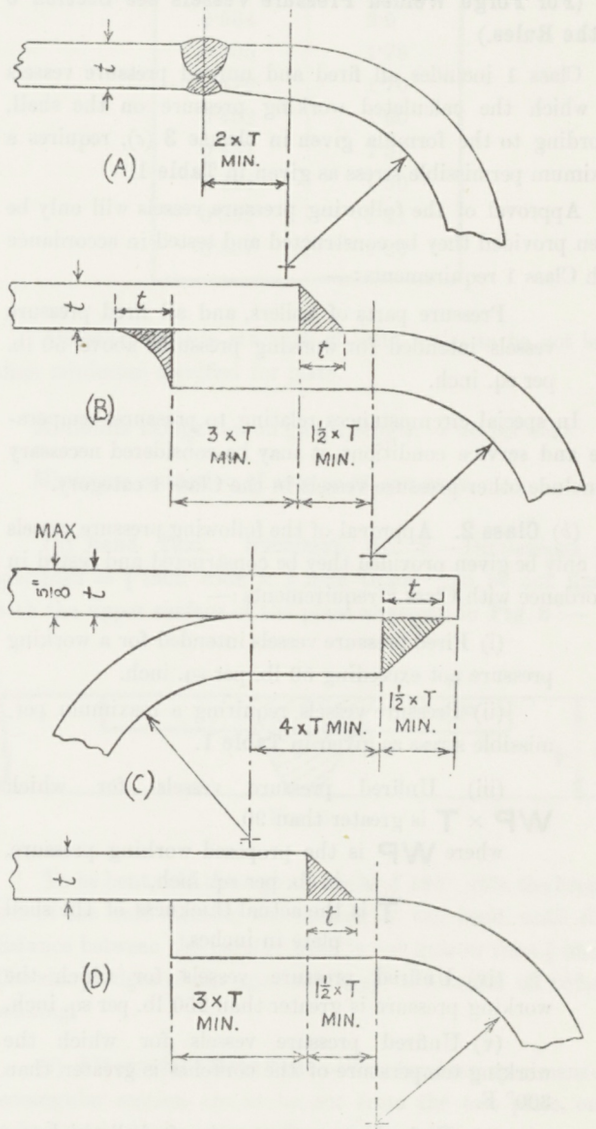
Type (G).—Acceptable for working pressures not exceeding 150 lb. per sq. in. and temperatures not exceeding 500° F.

(*q*) Where a dished end plate, concave to the pressure is fixed by a fillet welded lap joint, the width of the overlap, measured between the edges of the end plate and shell plate, is not to be less than three times the thickness of the end plate. The outside fillet weld is to be clear of the knuckle of the flange.

Dished end plates convex to the pressure may be permitted, provided the thickness of the shell plate does not exceed $\frac{5}{8}$ inch, and the width of flange is not less than four times the thickness of the end plate.

Permissible forms of fusion welded circumferential joints for dished end plates are shown in **Fig. 4.**

FIG. 4. TYPICAL ACCEPTABLE METHODS OF ATTACHING DISHED ENDS TO CYLINDRICAL SHELLS.



T = thickness of dished end plate.

NOTE:—Types (B) (C) and (D) are not acceptable for Class 1 pressure vessels. Type (D) should only be used for Class 3 pressure vessels in which *t* does not exceed $\frac{1}{2}$ inch.

(*r*) Where a dished end plate is fixed by a butt joint, and the thickness of an end plate exceeds that of the shell, the end plate shall be gradually reduced to the thickness of the shell plate for a length not less than twice the thickness of the end plate, measured from the centre line of the weld.

4. **Classification of Fusion Welded Pressure Vessels.**—(*a*) **Class 1.** Pressure vessels made in accordance with the requirements of this class will be accepted only if they are constructed by firms whose names are included in the List of Firms recognised by the Committee for the manufacture of Class 1 welded pressure vessels (Fusion Welding).

(For Forge Welded Pressure Vessels see Section 6 of the Rules.)

Class 1 includes all fired and unfired pressure vessels for which the calculated working pressure on the shell, according to the formula given in **clause 3** (*c*), requires a maximum permissible stress as given in **Table 1.**

Approval of the following pressure vessels will only be given provided they be constructed and tested in accordance with Class 1 requirements:—

Pressure parts of boilers, and all fired pressure vessels intended for working pressures above 50 lb. per sq. inch.

In special circumstances relating to pressure, temperature and service conditions, it may be considered necessary to include other pressure vessels in the Class 1 category.

(*b*) **Class 2.** Approval of the following pressure vessels can only be given provided they be constructed and tested in accordance with Class 2 requirements:—

(i) Fired pressure vessels intended for a working pressure not exceeding 50 lb. per sq. inch.

(ii) Pressure vessels requiring a maximum permissible stress as given in **Table 1.**

(iii) Unfired pressure vessels for which $WP \times T$ is greater than 90.

where WP is the proposed working pressure, in lb. per sq. inch,

T is the actual thickness of the shell plate in inches.

(iv) Unfired pressure vessels for which the working pressure is greater than 250 lb. per sq. inch.

(v) Unfired pressure vessels for which the working temperature of the contents is greater than 300° F.

(vi) Unfired pressure vessels of shell thickness greater than $\frac{5}{8}$ inch.

(*c*) **Class 3.** This class includes all unfired pressure vessels not included in Classes 1 and 2 for which the calculated working pressure on the shell, according to the formula given in **clause 3** (*c*) requires a maximum permissible stress as given in **Table 1.**

Section 2. Class 1. Requirements for Fusion Welding.

1. **Preliminary Conditions and Tests.**—(*a*) In order that the name of a firm may be included in the List of Firms recognised by the Committee for the manufacture of Class 1 Welded Pressure Vessels (Fusion Welding), it will be necessary for the Surveyors to make a preliminary visit to the works for the purpose of inspecting the welding plant, equipment and procedure, also to arrange for the carrying out of a special series of tests as described in **Section 2, clause 1** (*d*). Subsequently the Surveyors will report periodically to the Committee on the conditions which obtain at the works, and if considered necessary will carry out further tests.

(*b*) The welding plant and equipment are to be of good quality and maintained in an efficient working condition. The welding apparatus is to be installed under cover and arranged so that the welding work may be carried out in positions free from draughts and adverse weather conditions. The procedure is to be such that there is regular and systematic supervision of the welding work, and the welding operators are to be subjected by the works officials to periodic tests for quality of workmanship. Records of these tests are to be kept and are to be available to the Surveyors for inspection.

(*c*) The Works should be equipped with an efficient testing laboratory which should include apparatus suitable for carrying out tensile, bend and impact tests, micro examination of specimens and X-ray examination of the actual joints in pressure vessels. The Works should also be equipped with a suitable heat treating furnace having satisfactory means for temperature control, but as an alternative, arrangements may be made whereby pressure vessels can be heat treated elsewhere.

(*d*) A series of special preliminary tests to demonstrate the quality of the welding work is to be carried out. The tests should include tensile, bend, impact, hardness and fatigue tests on specimens which should be prepared in a similar manner to that used in the making of longitudinal joints in pressure vessels. The Surveyors are to select portions of the test plates from which photomicrographs, at 100 and 300 magnifications, are to be prepared representing the weld centre, fusion zone and plate. The test plates from which the specimens are taken, are to be X-rayed.

(*e*) A chemical analysis, including determination of oxygen and nitrogen content, is to be made of weld metal deposited in a sample joint in which the parent plate material is similar to that normally used in the manufacture of welded pressure vessels. A chemical analysis of the plates forming the sample joint should also be made, alternatively a guaranteed analysis obtained from the steel-makers will be accepted.

(*f*) A full size welded pressure vessel is to be manufactured under survey, and is to comply in every respect with the requirements for Class 1 pressure vessels.

2. **Class 1. Routine Tests for each Welded Pressure Vessel.**—(*a*) Two test plates should be prepared for each pressure vessel. They should be attached to the shell plate in such a manner that the edges to be welded are a continuation and duplication of the corresponding edges of a longitudinal joint. The welding process, procedure and technique are to be the same as employed in the welding of the longitudinal joint. Test plates are to be so supported during welding, that warping is reduced to a minimum.

(*b*) The test plates are to be straightened before being subjected to the same heat treatment as given to the pressure vessel.

(*c*) Test plates need not be prepared for the circumferential seams, except in cases where a pressure vessel has circumferential seams only, when two test plates are to be prepared, each having a welded joint which, so far as possible, is a duplication of the circumferential seams.

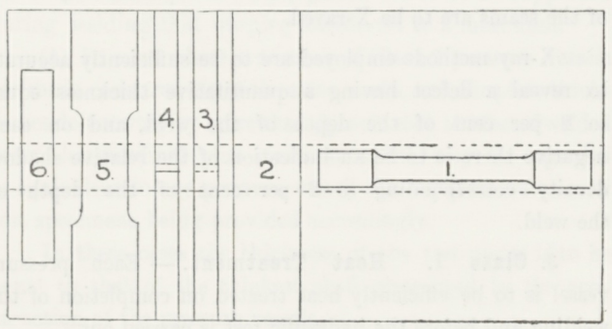
(*d*) The material for the test plates is to conform to the same specification as the shell plates of the pressure vessel.

(*e*) The thickness of test plates is to be the same as that of the pressure vessel.

(*f*) One test plate is to be cut up into test specimens as shown in **Fig. 5**. All the specimens are to be cut from a plate of suitable length and are to comply with the test requirements detailed as follows :—

(1) Tensile, all weld metal.
(2) Bend.
(3) Impact (inner surface).
(4) Impact (outer surface).
(5) Tensile (Joint).
(6) Macro.

FIG. 5.



Retests.—If any of the tests fail, two retests are to be made on specimens cut from the second test plate.

All retests are to comply fully with the test requirements.

(*g*) **Tensile Test for Weld Metal. Specimen No. 1.**—

Diameter of Test Piece. in.	Gauge Length. in.
0·798	2·82
0·564	2·0
0·505	1·79
0·479	1·70
0·452	1·60
0·437	1·55
0·424	1·50
0·399	1·41
0·357	1·26

Ultimate tensile strength of weld metal to be not less than minimum specified for plate.

Minimum elongation on gauge length = 20 per cent.

Minimum reduction of area = 35 per cent.

(*h*) **Bend Test. Specimen No. 2.**—Dimensions of specimen = $\frac{3}{4}$ inch wide × $\frac{3}{8}$ inch thick. To be cut flush with the upper surface of the plate as shown in **Fig. 6** :—

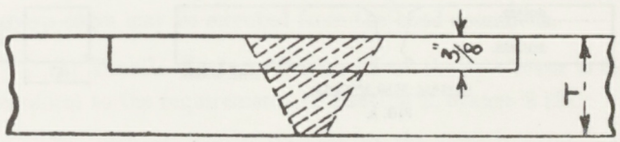


FIG. 6.

To be bent cold through an angle of 180°, with the broad side of the weld forming the outside of the bend, until the distance between the parallel sides is not greater than $\frac{3}{8}$ inch. The sharp edges of the specimen may be rounded off before bending.

(*i*) **Alternative Bend Test.**—Two bend test specimens of rectangular section are to be cut from the test plate, one to be bent with the outer surface of the weld in tension, and the other with the inner surface in tension.

The specimens are to be cut transversely to the weld and are to have a width equal to $1\frac{1}{2}$ times the thickness of the specimen. The edges may be rounded off to a radius not exceeding 10 per cent. of the thickness of the specimen.

In plate thicknesses not exceeding $1\frac{1}{4}$ inches, the thickness of the specimens should be equal to the thickness of the test plate. Where the plate thickness exceeds $1\frac{1}{4}$ inches, the specimens should, in all cases, have a thickness of $1\frac{1}{4}$ inches, and width of $1\frac{7}{8}$ inches. These should be prepared by discarding metal from the surfaces of the specimens which will be in compression when the test is applied. (*See* **Figs. 7** and **8.**)

Where the thickness of the plate permits, the bend specimens may be prepared as shown in **Fig. 9.**

For each specimen the weld reinforcement should be removed by buffing or machining so that the outer and inner surfaces of the weld are flush with the surface of the plate.

Each specimen is to be bent cold without fracture through an angle of 180°, over a former having diameter equal to three times the thickness of the specimen. The distance between supports should be not more than 5·2 times the thickness of the specimen.

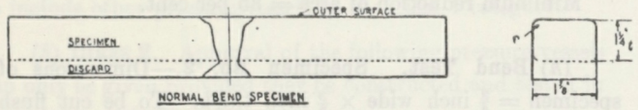


FIG. 7.

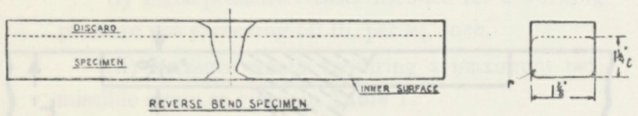


FIG. 8.

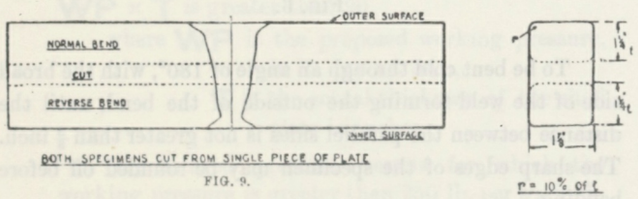


FIG. 9.

(*j*) **Impact Test. Specimens Nos. 3 and 4.**—Dimensions 0·394 inch square. One specimen to have a milled V notch cut in the centre of the outer surface of the weld and the other at the centre of the inner surface of the weld. Minimum IZOD value = 25 ft. lb.

(*k*) **Tensile Test for Joint. Specimen No. 5.**

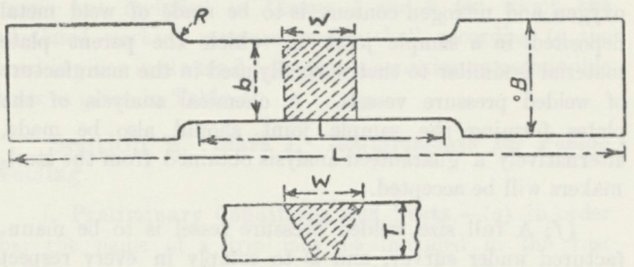


FIG. 10.

Dimensions (Fig. 10):—

When T is less than 1 inch:—

L = 10 inches.

l = w + $\frac{1}{2}$ inch. R = $\frac{3}{16}$ inch.

B = $1\frac{1}{4}$ inches.

b = $\frac{7}{8}$ inch.

When T is greater than 1 inch:—

L = 12 inches.

l = w + $\frac{1}{2}$ inch. R = $\frac{1}{4}$ inch.

B = $1\frac{1}{2}$ inches.

b = 1 inch.

An equivalent form of test piece to the above may be accepted.

The weld is to be machined flush with plates on both sides.

Ultimate tensile strength to be not less than minimum specified for plate.

(*l*) **Macro Specimen. Specimen No. 6.**—The specimen is to be etched across the full section of the weld, and examined by the Surveyor.

(*m*) **X-ray Examination.**—X-ray photographs are to be taken of the entire length of each welded seam, both longitudinal and circumferential. The photographs are to be marked in such a way that the corresponding portion of the welded seam can readily be identified. The negatives are to be examined by the Surveyor who will indicate whether any rewelding is necessary.

On completion of the rewelding, the affected portions of the seams are to be X-rayed.

X-ray methods employed are to be sufficiently accurate to reveal a defect having a quantitative thickness equal to 2 per cent of the depth of the weld, and on each negative there is to be an indication of the relative shadow density corresponding to 2 per cent of the depth of the weld.

3. **Class 1. Heat Treatment.** — Each pressure vessel is to be efficiently heat treated on completion of the welding and before the hydraulic test is carried out.

The heat treatment given to any pressure vessel may be either :—

(1) Normalizing, in which the pressure vessel is heated uniformly to a temperature of 920° C. and allowed to cool slowly in still air.

(2) Stress Relieving, in which the pressure vessel is heated uniformly to a temperature between 600° C and 650° C., and allowed to cool slowly in still air.

4. **Class 1. Hydraulic Test.**—For pressure vessels intended for working pressures up to 100 lb. per square inch, the hydraulic test pressure is to be twice the working pressure. Where working pressures exceed 100 lb. per square inch, the hydraulic test pressure is to be $1\frac{1}{2}$ times the working pressure plus 50 lb. per square inch.

Whilst under this test the pressure vessel is to be well hammered on both sides of, and close to, the welded seams.

5. **Modification of Requirements.**—In the case of firms of large experience some modification may be permitted in regard to the requirements of **Section 2, clause 1** and to the requirements relating to Routine Tests for Class 1 Welded Pressure Vessels.

Section 3. Class 2. Requirements for Fusion Welding.

1. **Preliminary Conditions.**—The welding of Class 2 Pressure Vessels is to be done only by firms who satisfy the Committee that their works are properly equipped for the welding of pressure vessels.

The welding plant is to be installed under cover and is to be maintained in an efficient working condition and adequate supervision of the welding work is to be provided.

2. **Class 2. Routine Tests for each Welded Pressure Vessel.**—(*a*) Two test plates should be prepared for each pressure vessel. They should be attached to the shell plate in such a manner that the edges to be welded are a continuation and duplication of the corresponding edges of a longitudinal joint. The welding process, procedure and technique are to be the same as employed in the welding of the longitudinal joint. Test plates are to be so supported during welding that warping is reduced to a minimum.

(*b*) In cases where a number of Class 2 pressure vessels are made concurrently at the same works, and the plate thicknesses do not vary by more than $\frac{3}{16}$ inch, each 120 feet of welded seam, longitudinal plus circumferential, may be regarded as equivalent to one pressure vessel, the required number of test specimens being provided accordingly.

In these cases the thickness of the test plates is to be equal to that of the thickest shell plate used in the construction of the pressure vessels.

(*c*) The test plates are to be straightened before being subjected to the same heat treatment as given to the pressure vessel.

(*d*) Test plates need not be prepared for the circumferential seams, except in cases where a pressure vessel has circumferential seams only, when two test plates are to be prepared each having a welded joint which, so far as possible, is a duplication of the circumferential seams.

(*e*) The material for the test plates is to conform to the same specification as the shell plates of the pressure vessel.

(*f*) The thickness of test plates is to be the same as that of the pressure vessel.

(*g*) One test plate is to be cut up into test specimens as shown in **Fig. 11.** All the specimens are to comply with the test requirements detailed as follows :—

		TENSILE.
		BEND.
		TENSILE.
		BEND.
		NICKED BEND.

FIG. 11.

Specimens may be dressed in way of the weld and the sharp edges may be removed from the bend specimens.

(*h*) **Tensile Tests.**—The shape of the specimens is to conform to the requirements of **Section 2, clause 2** (*k*).

The ultimate tensile strength of the joint is to be not less than the minimum specified for the plate.

(*j*) **Bend Tests.**—The width of the bend specimens is to be not less than $1\frac{1}{2}$ times the thickness, and the mid portion of the specimens is to coincide with the centre line of the weld. One specimen is to be bent with the outer surface of the weld in tension, and the other specimen is to be bent with the outer surface of the weld in compression.

In both cases the specimens are to be bent without fracture through 180° round a former, the diameter of which is not greater than 3 times the thickness of the specimen.

(*k*) **Nicked Bend Test.**—The specimen is to have a slot cut into each side of the weld. The specimen is then to be broken in the weld and the fracture is to reveal a sound homogeneous weld, substantially free from slag inclusions porosity and coarse crystallinity.

(*l*) **Retests.**—If any of the tests fail, two retests are to be made on specimens cut from the second test plate. All retests are to comply fully with the test requirements.

3. **Class 2. Heat Treatment.**—Where heat treatment is required to be carried out in respect of any pressure vessel (*see* Table 1), the requirements of **Section 2, clause 3,** are to be complied with.

Pressure vessels for which the ratio of inside diameter in inches to the cube of the shell thickness in inches is less than 100 are to be efficiently heat treated.

4. **Class 2. Hydraulic Test.**—For pressure vessels intended for working pressures up to 100 lb. per square inch, the hydraulic test pressure is to be twice the working pressure. Where working pressures exceed 100 lb. per square inch, the hydraulic test pressure is to be $1\frac{1}{2}$ times the working pressure plus 50 lb. per square inch.

Whilst under this test the pressure vessel is to be well hammered on both sides of, and close to, the welded seams.

Section 4. Class 3. Requirements for Fusion Welding.

1. **Preliminary Conditions.**—The welding of Class 3 Pressure Vessels is to be done only by firms who satisfy the Committee that their works are properly equipped for the welding of pressure vessels.

The welding plant is to be installed under cover and is to be maintained in efficient working condition and adequate supervision of the welding work is to be provided.

2. **Class 3. Optional Routine Tests for each Welded Pressure Vessel.**—(*a*) Pressure vessels which comply with the following test requirements, including heat treatment, will be allowed the maximum permissible stress given in **Table 1** for Class 3 pressure vessels.

The permissible stresses are reduced when heat treatment and routine tests are omitted. (*See* **Table 1.**)

In the case of pressure vessels having a shell plate thickness not exceeding $\frac{3}{8}$ inch, double fillet lap joints for the longitudinal seams will be permitted in conjunction with a maximum permissible stress as given in **Table 1.** In this case heat treatment and routine tests may be omitted.

(*b*) Two test plates should be prepared for each pressure vessel. They should be attached to the shell plate in such a manner that the edges to be welded are a continuation and duplication of the corresponding edges of a longitudinal joint. The welding process, procedure and technique are to be the same as employed in the welding of the longitudinal joint. Test plates are to be so supported during welding that warping is reduced to a minimum.

(*c*) The test plates are to be straightened before being subjected to the same heat treatment as given to the pressure vessel.

(*d*) The material for the test plates is to conform to the same specification as the shell plates of the pressure vessel.

(*e*) The thickness of test plates is to be the same as that of the pressure vessel.

(*f*) One test plate is to be cut up to provide one tensile, one bend and one nicked bend specimen.

(*g*) **Tensile Test.**—The shape of the specimen is to conform to the requirements of **Section 2, clause 2** (*k*). The ultimate tensile strength of the joint is to be not less than 95 per cent. of the minimum specified for the plate.

(*h*) **Bend Test.**—The width of the bend specimen is to be not less than $1\frac{1}{2}$ times the thickness, and the centre of the specimen is to coincide with the centre line of the weld. The specimen is to be bent with the outer surface of the weld in tension, through an angle of 160° without fracture round a former the diameter of which is not greater than 3 times the thickness of the specimen.

(*j*) **Nicked Bend Test.**—The specimen is to have a slot cut into each side of the weld. The specimen is then to be broken in the weld and the fracture is to reveal a sound homogeneous weld, substantially free from slag inclusions porosity and coarse crystallinity.

(*k*) **Retests.**—If any of the tests fail, two retests are to be made on specimens cut from the second test plate. All retests are to comply fully with the test requirements.

(*l*) In cases where a number of Class 3 pressure vessels are made concurrently at the same works, and the plate thicknesses do not vary by more than $\frac{3}{16}$ inch, each 120 feet of welded seam, longitudinal plus circumferential, may be regarded as equivalent to one pressure vessel, the required number of test specimens being provided accordingly.

In these cases, the thickness of the test plates is to be equal to that of the thickest shell plate used in the construction of the pressure vessels.

(*m*) Test plates are not required in the case of pressure vessels having circumferential welded seams only.

3. **Class 3. Heat Treatment.**—Class 3. Pressure Vessels may be required to be heat treated, depending upon the details of design and the service for which the pressure vessels are intended.

Where heat treatment is required to be carried out on any pressure vessel, the requirements of **Section 2, clause 3,** are to be complied with.

4. **Class 3. Hydraulic Test.**—For pressure vessels intended for working pressures up to 100 lb. per square inch, the hydraulic test pressure is to be twice the working pressure. Where working pressures exceed 100 lb. per square inch, the hydraulic test pressure is to be $1\frac{1}{2}$ times the working pressure plus 50 lb. per square inch.

Whilst under this test the pressure vessel is to be well hammered on both sides of, and close to, the welded seams.

Section 5. Inspection of Fusion Welded Pressure Vessels.

NOTE :—The following requirements are applicable to all classes of fusion welded pressure vessels.

1. **Electrodes.**—(*a*) In the case of pressure vessels welded by the electric metallic arc process, the electrodes are to be of a type conforming to the terms of the definition for fusion welds given in **Section 1, clause 1** (*a*).

(*b*) Electrodes intended for use in the construction of pressure vessels are to be stored in a dry place. In order to ensure that the quality of the electrodes is being consistently maintained they are to be subjected to a regular system of periodic testing and inspection. Where routine tests are frequently carried out in respect of pressure vessels made in the normal course of production, such tests may be regarded as meeting the requirements of this clause.

(*c*) In cases in which it is proposed to use electrodes of larger size than $\frac{3}{8}$ inch diameter, full particulars are to be submitted for consideration.

2. **Heat Treatment.**—(*a*) The heat treatment of pressure vessels is to be carried out by placing the pressure vessels in a properly constructed furnace having satisfactory means of temperature control.

(*b*) Where pressure vessels are of such dimensions that the whole length cannot be accommodated in the furnace at one time, the pressure vessels may be heated in sections provided sufficient overlap is allowed to ensure the heat treatment of the entire length of the longitudinal seam.

(*c*) Test plates should be heat treated in the same furnace and at the same time as the pressure vessels which they represent. In special cases, however, it may be permissible to heat treat the test plates separately from the pressure vessels provided the Surveyor is satisfied with the means adopted to ensure that the following factors will be the same for the pressure vessels as for their respective test plates :—

Rate of heating.
Maximum temperature.
Time held at maximum temperature.
Conditions of cooling.

(*d*) Where a number of test plates are heated together in a furnace, care is to be taken to ensure that each plate is uniformly exposed to the heat of the furnace.

(*e*) In cases where it is proposed to adopt special methods of heat treatment full particulars are to be submitted for consideration. In such cases it may be necessary to carry out tests to show the effect of the proposed heat treatment.

3. **Welding Technique.**—(*a*) Welding may be carried out by hand or by machine, and the current used in electric metallic arc welding may be direct or alternating. In welding branch pieces, pads and compensating rings, more than one run of weld metal is to be deposited. Longitudinal and circumferential seams may be reinforced by additional runs of weld metal but in the case of Class 1 pressure vessels, the outer layer of the reinforcement is subsequently to be removed by means of chipping or grinding.

(*b*) The outer surfaces of the welds may be flush with the surfaces of the plates joined, but no objection will be raised if the total thickness at the centre of the weld is greater than the thickness of the plates, provided the change of section is gradual and there is no undercutting at the sides of the weld.

(*c*) Each run of weld metal is to be thoroughly cleaned and free from slag before the next run is deposited.

(*d*) In all Class 1 pressure vessels, the longitudinal and circumferential seams are to be welded from both sides of the plate. In the case of Class 2 and Class 3 pressure vessels which are too small to permit welding from the inside, special care should be taken to ensure full penetration of the first run of weld metal. In such cases it is recommended that a backing strip be provided on the underside of the joint. In order to satisfy himself regarding the penetration, the Surveyor may, if he considers it necessary, request that a sample joint be welded and cut open for his inspection.

(*e*) The welding of pressure vessels is to be carried out in the downhand horizontal position. In the case of circumferential seams means are to be adopted to ensure compliance with this requirement.

(*f*) In cases where it is proposed to adopt fusion welding processes in which it may not be possible to comply fully with the foregoing requirements regarding technique, full particulars are to be submitted for consideration.

4. **Fabrication.**—(*a*) Before welding, the assembly is to be examined. The shape and size of the joints are to be in accordance with the approved design. The butting edges of the plates forming the longitudinal and circumferential seams are to be in line within a limit of 10 per cent. of the plate thickness, but in no case exceeding $\frac{1}{8}$ inch for longitudinal joints and $\frac{3}{16}$ inch for circumferential joints.

(*b*) The attachment of branches should be examined before and after welding.

(*c*) During fabrication, the Surveyor is to be provided with opportunities for seeing the actual deposition of weld metal. The joints are to be examined at various stages during construction.

(*d*) On completion of the welding, the seams are to be thoroughly examined before being dressed or machined. Parts showing evidence of blow-holes, slag inclusions, unsatisfactory penetration, porosity, or any other defect, are to be cut out and rewelded, and excessive undercutting made good.

(*e*) Each pressure vessel is to be calibrated for distortion. The calibration is to be made after the heat treatment has been carried out. The drum or shell is to be circular at any section within a limit of one per cent. of the designed internal diameter based on the difference between the maximum and minimum diameters of any section. Any departure from circularity is to be gradual and there is to be no local flat in way of the welded seam.

Section 6.—REQUIREMENTS FOR CONSTRUCTION AND TESTING OF FORGE WELDED PRESSURE VESSELS.

1. **Classification of Forge Welded Pressure Vessels.**—(*a*) **Class 1.** Pressure vessels made in accordance with the requirements of this class will be accepted only if they are constructed by firms whose names are included in the List of Firms recognised by the Committee for the manufacture of Class 1 welded pressure vessels (Forge Welding).

Class 1 includes all fired and unfired pressure vessels for which the calculated working pressure on the shell, according to the formula given in **Section 1, clause 3** (*c*), requires a maximum permissible stress as given in **Table 2.**

Approval of the following pressure vessels will only be given provided they be constructed and tested in accordance with Class 1 requirements :—

Pressure parts of boilers, and all fired pressure vessels intended for working pressures above 50 lb. per sq. inch.

In special circumstances relating to pressure, temperature and service conditions, it may be considered necessary to include other pressure vessels in the Class 1 category.

(*b*) For Forge Welded Pressure Vessels not included in Class 1 the working pressure of the shell is to be calculated from the formula shown in **Section 1, clause 3** (*c*), the maximum permissible stress being as given in **Table 2.**

TABLE 2.

MAXIMUM PERMISSIBLE STRESSES IN THE LONGITUDINAL JOINTS OF FORGE WELDED PRESSURE VESSELS, FOR TEMPERATURES NOT EXCEEDING 650° F.

		Minimum tensile strength 24 Tons per sq. in.	Minimum tensile strength 26 Tons per sq. in.
CLASS 1.	Unfired vessels.	11,200 lb. per sq. in.	12,200 lb. per sq. in.
	Fired vessels.	10,600 lb. per sq. in.	11,500 lb. per sq. in.
All other Classes.	Where shell thickness is $\frac{5}{8}$ in. and above.	9,900 lb. per sq. in.	10,800 lb. per sq. in.
	Where shell thickness is less than $\frac{5}{8}$ in.	9,200 lb. per sq. in.	10,000 lb. per sq. in.

2. **Class 1. Preliminary Conditions and Tests.**—(*a*) In order that the name of a firm may be included in the List of Firms recognised by the Committee for the manufacture of Class 1 Welded Pressure Vessels (Forge Welding), it will be necessary for the Surveyors to make a preliminary visit to the works for the purpose of inspecting the welding plant, equipment and procedure also to arrange for the carrying out of a special series of tests as described in **Section 6, clause 1** (*d*). Subsequently the Surveyors will report periodically to the Committee on the conditions which obtain at the works, and if considered necessary will carry out further tests.

(*b*) The welding plant and equipment are to be of good quality and maintained in efficient working condition. The

welding plant is to be installed under cover and arranged so that the welding work may be carried out in positions free from draughts and adverse weather conditions. The procedure is to be such that there is regular and systematic supervision of the welding work.

(*c*) The Works should be equipped with an efficient testing laboratory which should include apparatus suitable for carrying out tensile, bend and impact tests, and micro examination. The Works should also be equipped with a suitable heat treating furnace having satisfactory means for temperature control, but as an alternative, arrangements may be made whereby pressure vessels can be heat treated elsewhere.

(*d*) A series of special preliminary tests to demonstrate the quality of the welding work is to be carried out. The tests should include tensile, bend, impact, hardness and fatigue tests on specimens which should be prepared in a similar manner to that used in the making of longitudinal joints in pressure vessels. The Surveyors are to select portions of the test plates from which photomicrographs, at 100 and 300 magnifications, are to be prepared representing the weld centre, and the plate remote from the weld.

(*e*) A full size pressure vessel is to be manufactured under survey, and is to comply in every respect with the requirements for Class 1 Forge Welded Vessels.

(*f*) In the case of firms of large experience some modification may be permitted in regard to the requirements of **Section 6, clause 2** (*d*) above, provided satisfactory evidence is produced of successful results obtained by the firm's welding methods, over an appreciable period.

3. Class 1. Routine Tests for each Welded Pressure Vessel.—(*a*) The shell plates are to be left long enough to accommodate the following test specimens :—

(1) Two Tensile specimens. } With provision
(2) Four Bend specimens. } for retests.

(*b*) **Tensile Test.**—The tensile specimens are to conform to the Standard Test Piece A, the mid portion of the test specimens coinciding with the weld.

The ultimate tensile strength of both test pieces is to be not less than 95 per cent. of the minimum specified for the plate material. The elongation is to be not less than 18 per cent on a gauge length of 8 inches.

(*c*) **Bend Tests.**—The width of the bend specimens is to be not less than $1\frac{1}{2}$ times the thickness, and the centre of the specimens is to coincide with the centre line of the weld. Two specimens are to be bent in such a manner that the outer surface of the weld is in tension, and two specimens are to be bent with the outer surface of the weld in compression.

In both cases the specimens are to be bent without fracture through 180° round a former, the diameter of which is not greater than 3 times the thickness of the specimen.

NOTE :—Some modification of the requirements contained in paragraphs (*a*), (*b*) and (*c*) may be permitted in circumstances such as are indicated in **clause 2** (*f*).

(*d*) **Retests.**—If any of the tests fail, two retests are to be made, both of which are to comply fully with the test requirements.

(*e*) In the case of pressure vessels having circumferential joints only, no test pieces need be provided unless the internal diameter of the pressure vessel exceeds 4 ft. 6 ins., when a representative welded joint is to be made and cut up to provide the specimens detailed above.

4. In the case of forge welded pressure vessels other than those included in Class 1 routine tests are not required in respect of longitudinal joints, but where the internal diameter of a pressure vessel exceeds 4 ft. 6 ins. the manufacturer is to produce authoritative evidence of test results demonstrating that efficient circumferential welds of the proposed dimensions can be made consistently.

5. **Heat Treatment.**—All forge welded pressure vessels are to be efficiently normalized in accordance with the requirements of **Section 2, clause 3** (1).

6. **Hydraulic Test.**—Pressure vessels are to be subjected to a hydraulic test pressure of twice the working pressure. Whilst under this test the pressure vessel is to be well hammered on both sides of, and close to, the welded seams.

7. **Plate Thickness.**—In the case of all pressure vessels the thickness of the shell plate is to be not less than $\frac{1}{4}$ inch.

8. **Weld Thickness.**—On completion of the welding the thickness at and adjacent to the weld is to be not less than the required thickness of the shell plate as determined from the formulæ for the Working Pressure given in **Section 1, clauses 3** (*c*) and 3 (*d*).

9. **Heating.**—The heating of plates for welding is to be carried out by means of a process which will provide a flame which will not be of an oxidizing character and will not tend to introduce impurities into the steel. Provision is to be made for careful control of the welding heat.

APPENDIX.

List of Firms recognised by the Committee, for the manufacture of Class 1 Welded Pressure Vessels, as at October, 1946.

Fusion Welding:—

Babcock & Wilcox, Ld., Renfrew, Scotland.

John Thompson (Wolverhampton), Ld., Wolverhampton, England.

Sulzer Bros., Winterthur, Switzerland.

Brown-Boveri, Ld., Baden, Switzerland.

The Foster Wheeler Corporation, Carteret, N.J., U.S.A.

The Sun Shipbuilding & Dry Dock Co., Chester, Pa., U.S.A.

The Babcock & Wilcox Company, Barberton, Ohio, U.S.A.

G. A. Harvey & Co. (London), Ld., London.

Combustion Engineering Co., Inc., New York, U.S.A. (Works at Chattanooga, Tennessee).

A. O. Smith Corporation, Milwaukee, Wisconsin, U.S.A.

Ruston & Hornsby, Ld., Lincoln, England.

Dominion Bridge Co., Ld., Lachine, Quebec, Canada.

Daniel Adamson & Co., Ld., Dukinfield, Cheshire, England.

Henry Balfour & Co., Ld., Leven, Fife, Scotland.

Aktiebolaget Lindholmens Varv., Gothenburg, Sweden.

Vancouver Iron Works, Ld., Vancouver, B.C., Canada.

Farrar & Trefts, Inc., Buffalo, New York, U.S.A.

The Broomside Boiler Works, Ld., Motherwell, Lanarkshire, Scotland.

Canadian Vickers, Ld., Montreal, Canada.

Avesta Jernverks Aktiebolag, Avesta, Sweden.

John Inglis & Co., Ld., Toronto, Canada.

Canadian General Electric Co., Ld. (Canadian Allis-Chalmers, Ld.), Davenport Works, Toronto, Canada.

Ashmore, Benson, Pease & Co., Ld., Parkfield Works, Stockton-on-Tees.

Cochran & Co., Annan, Ld., Annan, Scotland.

Heilman Boiler Works, Allentown, Pa., U.S.A.

John Brown & Co., Ld., Clydebank, Scotland.

South Durham Steel & Iron Co. Ltd., Stockton-on-Tees, England.

Forge Welding:—

John Thompson (Wolverhampton) Ld., Wolverhampton, England.

71, Fenchurch Street, London, E.C.3.

17th October, 1946.

PETROL AND PARAFFIN ENGINES

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PETROL AND PARAFFIN ENGINES

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RULES FOR THE CONSTRUCTION AND SURVEY OF PETROL AND PARAFFIN ENGINES.

GENERAL.

Section 1. In vessels propelled by Petrol or Paraffin Engines, the Rules as regards Machinery are the same as those relating to steam engines so far as regards the testing of material used in their construction and the fitting of sea connections, discharge pipes, shafting, stern tubes and propellers. Where it is proposed to depart from the requirements of the Rules, the Committee will be prepared to give consideration to the circumstances of any special case.

CONSTRUCTION.

Section 2. 1. In order to facilitate the inspection, plans in triplicate of the following items are to be submitted for consideration before the work is commenced :—

(*a*) Crankshaft.

(*b*) Clutch, reversing and reduction gear.

(*c*) Screwshaft.

(*d*) Fuel tanks not forming part of the structure of the vessel. (*See the* **Rules for Steel Ships, Section 20D, clause 2.**)

(*e*) Fuel piping arrangements.

(*f*) Bilge and ballast pumping arrangements. (*See the* **Rules for Steel Ships, Section 34**).

2. The following points are to be observed in connection with the design of the engines.

3. The shaft bearings, connecting rod brasses, the valve gear, the inlet and exhaust valves are to be easily accessible.

4. The reversing gear and clutch are to be strongly constructed and easily accessible for examination and adjustment.

5. In engines of above 60 B.H.P. which are not reversible and which are manœuvred by clutch, a governor or other arrangement is to be fitted to prevent racing of the engine when de-clutched.

6. Engines intended for driving electric generators are to comply with the requirements of the **Rules for Electrical Equipment, Section 2, clauses 1, 12, 16** and **17,** where these are applicable.

7. Where the lubricating oil for main engines is circulated under pressure, provision is to be made for efficiently straining the oil. Where strainers are on the discharge side of the oil pump a relief valve, in close circuit, is to be fitted between the pump and the strainer.

The strainers or filters are to be capable of being cleaned without stopping the oil supply to the engines.

8. In vessels intended for open sea service and fitted with engines over 350 B.H.P. in which the lubricating oil is circulated under pressure, a spare oil pump is to be supplied with all connections ready for immediate use, and two independent means are to be arranged for circulating water through the oil cooler, where this is fitted.

9. If the engines are of the closed-in type, they are to be so fitted that the contained lubricating oil can be drained when necessary, and in wood vessels an easily drained metal or metal-lined tray is to be fitted to prevent leakage of either fuel oil or of lubricating oil from saturating the woodwork.

10. Carburettors, where petrol is used, and vaporizers where paraffin is used, are to be so designed that when the engine is stopped the fuel supply is automatically shut off. If an overflow is provided in the carburettor or vaporizer, a gauze covered tray with means of draining it is to be fitted to prevent the fuel from flowing into the bilges.

Strong metallic gauze diaphragms are to be fitted either between the carburettor (or vaporizer) and cylinders, or at the air inlets.

11. If the ignition is electric, either by magneto or by coil and accumulator, all electric leads are to be well insulated and suitably protected from mechanical injury. The leads are not to be placed where they may be brought into contact with oil or petrol.

The commutator is to be enclosed, and the sparking coils are not to be placed where they can be exposed to explosive vapour.

12. In paraffin engines where lamps are used for ignition or for vaporizing, these lamps are to be fixed by some suitable bracket, and the flame enclosed when in use.

13. The water circulating pump sea suction is to have a cock or valve on the vessel's skin placed on the turn of the bilge in an easily accessible position, and the circulating pipe is to be provided with an efficient strainer which can be cleared inside the vessel. The discharge overboard is to be fitted with a cock or valve on the vessel's skin if it is situated under or near the load line of the vessel.

14. (*a*) The pumping arrangements are to be the same as would be required for steam vessels of similar size and power, with the exception that a bilge suction need not be fitted to the main engine water circulating pump. In the cases of vessels fitted with water ballast, the water ballast pump is to be fitted with a direct suction from the engine room bilges.

(*b*) In open launches and in auxiliary vessels not greater than 80 feet Rule length, power pump suctions may be dispensed with, provided manual pumps be fitted for the purpose of efficiently draining each compartment which is situated below the upper deck.

The manual pumps are to be workable from the upper deck, and the tail pipes are to be fitted with suction roses.

The inside diameters of the tail pipes of manual pumps are to be $\frac{1}{4}$ inch for every 25 feet of the Rule length plus one inch. No tail pipe is, however, to be less than $1\frac{1}{4}$ inches or need be more than $2\frac{1}{2}$ inches bore, except in vessels not greater than 25 feet Rule length, where they may be 1 inch bore.

The diameters of the barrels of manual pumps are to be twice the diameter of their tail pipes.

15. Where the cylinder liners are made of hard close grained cast iron of plain cylindrical form, accurately turned on the outside as well as bored on the inside, so that their soundness can be ascertained by inspection, they need not be hydraulically tested by internal pressure. If, however, they are made of complicated form, the question of testing is to be submitted.

16. The water jackets of the cylinders, and the water passages of the cylinder covers and pistons are to be tested by hydraulic pressure to 30 lb. per square inch and are to be perfectly tight at that pressure.

17. The exhaust pipes and silencer are to be efficiently water cooled or lagged to prevent damage by heat, and if the exhaust is led overboard near the water-line, means are to be provided to prevent water from being syphoned back to the engine.

18. If compressed air receivers are fitted, they are to comply with the requirements of **Section 6 (Rules for Heavy Oil Engines)**.

19. The machinery is to be tried under full working conditions, the report stating the approximate speed of vessel, the number of revolutions of the engines at full power, both ahead and astern, and the lowest number of revolutions of the engines which can be maintained for manœuvring purposes.

RULES FOR DETERMINING SIZES OF SHAFTS.

Section 3. 1.—(*a*) The crank, intermediate and other shafts, if of ordinary mild steel having a tensile breaking strength of 28–32 tons per square inch, are to be of not less diameters than those given by the following formulæ. The formulæ do not, however, take into consideration the possibility of severe torsional vibration stresses arising in the shafting and where the circumstances are such as to indicate that critical speeds will occur within the range of working speeds, the sizes of shafting are to be specially submitted for the consideration of the Committee.

(*b*) Where shafts are proposed to be made of special high tensile steel, their sizes should be submitted for consideration.

2. **Crank Shafts.**—The diameter of the crank shaft of the main engines is not to be less than that given by the following formula :—

$$\left.\begin{array}{l}\text{Diameter of crank}\\ \text{shaft, in inches}\\ \text{or millimetres}\end{array}\right\} = \sqrt[3]{D^2 \times (A\,S + B\,L)}$$

where D = diameter of cylinder, in inches or millimetres,

S = length of stroke, in inches or millimetres,

L = span of bearings adjacent to a crank, measured from inner edge to inner edge, in inches or millimetres.

The values of A and B given in Table I. apply to engines in which there are bearings adjacent to each side of each crank. If there are two cranks between consecutive bearings the same Rules will apply, but L will be the span of bearings from inner edge to inner edge adjacent to the two cranks.

TABLE I.

4 Cycle Single Acting Engines.	2 Cycle Single Acting Engines.	For Smooth Water Service Values of		For Open Sea Service Values of	
		A	B	A	B
1,2,3 or 4 Cyls.	1 or 2 Cyls.	·025	·022	·028	·024
6 „	3 „	·031	·021	·034	·023
8 „	4 „	·035	·020	·039	·022
12 „	6 „	·048	·017	·053	·019

3. For engines of the aforementioned types driving auxiliary machinery, the diameters of the crank shafts may be 5 per cent. less than given by the foregoing formula applying to main engines for open sea service.

4. **Crank Webs.**—In solid forged shafts the breadth of the webs should not be less than 1·33, and the thickness not less than ·56 times the diameter of the shaft as found by the foregoing formula or if these proportions are departed from, the webs are to be of equivalent strength.

5. **Intermediate Shafts.**—The diameter of the intermediate shafts is not to be less than that given by the following formula :—

$$\text{Diameter of intermediate shaft, in inches or millimetres} = C \sqrt[3]{D^2 \times S}$$

where D = diameter of cylinder, in inches or millimetres,

S = length of stroke, in inches or millimetres,

C is a coefficient found from Table II. by interpolation from the values found for A :—

$$A = \frac{D^2 \times S}{W \times d^2 \times R^2}$$

where D = diameter of cylinder, in inches,

S = length of stroke, in inches,

d = diameter of fly wheel, in feet,

R = revolutions of engines per minute,

W = total weight of fly wheel, in tons.

TABLE II.

FOR SMOOTH WATER SERVICE.

4 Cycle Single Acting Engines.	2 Cycle Single Acting Engines.	Values of the Coefficient C where A=·0025	A=·0050	A=·0100
2 Cyl.	1 Cyl.	·240	·250	·256
3 „	—	·255	·264	·270
4 „	2 „	·272	·277	·282
6 „	3 „	·298	·301	·304
8 „	4 „	·322	·324	·325
12 „	6 „	·363	·364	·365

FOR OPEN SEA SERVICE.

4 Cycle Single Acting Engines.	2 Cycle Single Acting Engines.	Values of the Coefficient C where A=·0025	A=·0050	A=·0100
2 Cyl.	1 Cyl.	·252	·262	·269
3 „	—	·269	·276	·283
4 „	2 „	·286	·291	·296
6 „	3 „	·313	·316	·319
8 „	4 „	·338	·340	·341
12 „	6 „	·382	·382	·383

6. If a separate fly wheel shaft is fitted its diameter is to be at least equal to that of the crank shaft.

7. **Thrust Shafts.**—The diameter at the collars of thrust shafts transmitting torque is not to be less than 1·05 times that required for the intermediate shaft. Thrust shafts may be tapered down outside the collars to the diameter required for the intermediate shaft.

8. **Tube Shafts** (shafts passing through stern tubes but not carrying the screw propellers).—The diameter of the tube shaft is not to be less than 1·05 times that required for the intermediate shaft, and any part of the shaft within the tube which may be exposed to sea water is not to be less than 1·075 times that required for the intermediate shaft.

9. **Screw Shafts** (shafts carrying the screw propellers) —(*a*) The diameter of the screw shaft is not to be less than that given by the following formula :—

$$\text{Diameter of screw shaft, in inches or millimetres} = d + \frac{P}{C}$$

where d is the diameter required for the intermediate shaft, in inches or millimetres,

P is the diameter of the propeller, in inches or millimetres,

C = 144 when the shaft is fitted with a continuous liner, or

C = 100 when the shaft is not fitted with a continuous liner.

(*b*) Screw shafts which run in stern tubes may have the end forward of the stern gland tapered down to a diameter, at the coupling flange, of 1·05 times d.

10. **Bronze Liners on Shafts.**—(*a*) The thickness of liners fitted on screw shafts, or on tube shafts, in way of the bushes, is not to be less than that given by the following formulæ :—

$$t = \frac{d + 9{\cdot}25}{32} \quad \text{or} \quad t_m = \frac{d + 235}{32}$$

where t is the thickness of the liner, in inches,

t_m is the thickness of the liner, in millimetres,

d is the diameter required for the screw or tube shaft under the liner, in inches or millimetres.

(*b*) The thickness of a continuous liner between the bushes is not to be less than $\frac{3}{4}t$ or $\frac{3}{4}t_m$.

(*c*) Continuous liners should be cast in one piece or, if made of two or more lengths, the junctions of the separate pieces are to be made by fusion through the whole thickness of the liner.

(*d*) Liners are to be carefully shrunk on, or forced on to the shafts by hydraulic pressure. Pins are not to be used to secure the liners.

(*e*) If the liner does not fit tightly between the bearings in the stern tube, the space between the shaft and the liner is to be charged or forced with a plastic material insoluble in water and non-corrosive.

(*f*) Effective means are to be provided for preventing water from having access to the shaft at the part between the after end of the liner and the propeller boss.

11. **Stern Bush.**—The length of the bearing in the stern bush next to and supporting the propeller is not to be less than 4 times the diameter required for the screw shaft under the liner.

12. **Couplings.**—(*a*) The diameter of the coupling bolts at the joining faces of the couplings is not to be less than that given by the following formula :—

$$\left.\begin{array}{l}\text{Diameter of coupling bolts,}\\ \text{in inches or millimetres ...}\end{array}\right\} = \sqrt{\frac{d^3}{3{\cdot}5 \times n \times r}}$$

where d is the diameter required for the intermediate shafts, in inches or millimetres,

n is the number of bolts in the coupling,

r is the radius of the pitch circle of the bolts, in inches or millimetres

(*b*) The thickness of the coupling flanges at the pitch circle of the bolt holes is not to be less than the diameter of the coupling bolts, at the face of the coupling. The thickness of the screw shaft coupling flange is not to be less than ·25 of the diameter required for the intermediate shaft.

(*c*) The radius of curvature at the fillet where the flange starts from the shaft should not be less than ·125 times the diameter of the shaft adjacent to the flange.

(*d*) Where couplings are separate from the shafts, provision is to be made to resist the astern pull.

13. **Bronze Propellers.**—Where bronze is used for propellers or propeller blades, it is to comply with the requirements of **Section 11** of the **Rules for Quality and Testing of Materials.**

PETROL AND PARAFFIN TANKS AND CONNECTIONS.

Section 4. 1. All fuel tanks and their fittings are to be in accordance with **Section 20, Rules for Steel Ships,** as far as applicable.

2. Strong and readily removable metallic gauze diaphragms are to be fitted at all openings on petrol tanks.

3. Glass gauges are not to be fitted to fuel tanks containing either petrol or paraffin.

4. Filling pipes are to be carried through the deck so that the gas displaced from the tanks has free escape to the atmosphere.

5. Separate fuel tanks are to be provided with metal or metal-lined trays to prevent any possible leakage from them flowing into the bilges, or saturating woodwork. Arrangements are to be provided for emptying the tanks and draining the trays beneath them. For petrol tanks the trays are to be fitted with drains leading overboard where possible or they are to be gauze-covered trays with means for draining them.

6. All petrol or paraffin fuel pipes are to be of annealed seamless copper with flexible bends. Their joints are to be conical, metal to metal. A cock or valve is to be fitted at each end of the pipe conveying the fuel from the tank to the carburettor or vaporizer. The fuel pipes are to be led in positions where they are protected from mechanical injury and can be exposed to view throughout their whole length.

7. The engine room, and the compartment in which the fuel tanks are situated, are to be efficiently ventilated.

8. An approved fire extinguishing apparatus is to be supplied.

Section 5. Spare Gear.—The items of spare gear to be carried for petrol and paraffin engines employed for essential services are to be equivalent to those required for heavy oil engines intended for similar services.

PERIODICAL SURVEYS.

Section 6. The periodical surveys of the machinery are detailed on page 25 under "**Petrol, Paraffin, and Heavy Oil Engines.**"

71, Fenchurch Street, London, E.C.3.
17th October, 1946.

HEAVY OIL ENGINES

AND THEIR AUXILIARIES

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RULES FOR THE CONSTRUCTION AND SURVEY OF HEAVY OIL ENGINES AND THEIR AUXILIARIES.

GENERAL.

Section 1. In vessels propelled by heavy oil engines, the Rules as regards Machinery are the same as those relating to steam engines, so far as regards the testing of material used in their construction and the fitting of sea connections, discharge pipes, shafting, stern tubes, and propellers.

CONSTRUCTION.

Section 2. 1.—In vessels built under Special Survey and fitted with heavy oil engines, the main and auxiliary engines, boilers, steering engines, all pumps, evaporators and feed water heaters and pressure filters intended for essential services, and domestic boilers intended for working pressures exceeding 50 lb. per square inch or having heating surfaces greater than 50 square feet are also to be constructed under Special Survey.

2. In cases of heavy oil engines being built under Special Survey, the distinguishing mark ✠ will be noted in the Register Book in Red, thus :—✠LMC or ✠NE.

3. In order to facilitate the inspection, plans in triplicate of the following items are to be submitted for consideration before the work is commenced :—

(*a*) Crankshafts.

(*b*) Clutch, reversing and reduction gear.

(*c*) Screwshaft.

(*d*) Air receivers.

(*e*) Oil fuel pumping arrangements and oil fuel tanks not forming part of the structure of the vessel. (*See the* **Rules for Steel Ships, Section 20D.**)

(*f*) Bilge and ballast pumping arrangements. (*See the* **Rules for Steel Ships, Section 34.**)

4. The Surveyors are to examine the materials and workmanship from the commencement of the work until the final test of the machinery under full power working conditions ; any defects are to be pointed out as early as possible.

5. Where it is proposed to depart from the requirements of these Rules, the Committee will be prepared to give consideration to the circumstances of any special case.

6. Any novelty in the construction of the machinery is to be reported to the Committee and submitted for approval.

SINGLE ACTING ENGINES.

Rules for Determining Sizes of Shafts.

Section 3. 1.—(*a*) The crank, intermediate and other shafts, if of ordinary mild steel having a tensile breaking strength of 28–32 tons per square inch are to be of not less diameters than those given by the following formulæ.

The formulæ do not, however, take into consideration the possibility of severe torsional vibration stresses arising in the shafting.

Calculations of the torsional vibration characteristics for the dynamic system formed by the engine, shafting and propeller, also gearing or generators, where these are interposed, are to be submitted for consideration, together with plans of all shafting. These calculations should include frequency tables for the one and two node natural frequencies, also three node where necessary, and particulars of the firing order. In drawing up frequency tables, the single amplitude of swing should be taken as one radian at the first mass at the end of the engine remote from the driving end. The vector summations are to be given for the relative angular displacements of the working cranks for all orders of vibration occurring at speeds less than 30 per cent. above the normal running speed.

Similar calculations are to be submitted for heavy oil engines of 100 B.H.P. or more driving auxiliary machinery used for essential services at sea.

In certain cases the Committee may consider it necessary for torsiograph readings to be taken from the machinery after fitting on board, for the purpose of verifying that serious critical speeds do not occur within the range of working speeds.

(*b*) Where shafts are proposed to be made of special high tensile steel, their sizes should be submitted for consideration.

2. **Crank Shafts.**—The diameter of the crank shaft of the main engines is not to be less than that given by the following formula :—

$$\left.\begin{array}{r}\text{Diameter of crank}\\ \text{shaft, in inches}\\ \text{or millimetres}\end{array}\right\} = \sqrt[3]{D^2 \times (AS + BL)}$$

where **D** = diameter of cylinder, in inches or millimetres,

S = length of stroke, in inches or millimetres,

L = span of bearings adjacent to a crank measured from inner edge to inner edge, in inches or millimetres.

A and **B** are coefficients dependent upon the designed maximum and mean indicated pressures and are found from **Table I.**

Where the designed maximum pressure and/or the designed mean indicated pressure are intermediate between the standard pressures given in **Table I.**, the coefficients **A** and **B** are to be found by interpolation between those given in the Table.

For heavy oil engines, with not more than three cylinders, driving auxiliary machinery the diameters of the crankshafts may be five per cent less than given by the foregoing formula.

3. **Crank Webs of Solid Forged Shafts.**—In solid forged shafts the breadth of the webs should not be less than 1·33 times and the thickness not less than ·56 times the diameter of the shaft as found by the foregoing formula, or, if these proportions are departed from, the webs are to be of equivalent strength.

4. **Crank Webs of Built Shafts.**—(*a*) The dimensions of the crank webs of built shafts are not to be less than those given by the following formulæ :—

$$h = \frac{\cdot 625 \times d}{t}$$

$$t = \sqrt{\frac{\cdot 12 \times d^3}{h}}$$

where h is the thickness of the web, measured parallel to the axis, in inches or millimetres,

t is the thickness of metal around the eyeholes measured radially, in inches or millimetres,

d is the diameter required for the crank shaft, in inches or millimetres.

(*b*) Crank webs are to be securely shrunk on the body pieces and crank pins. If dowels are not fitted at the junction of the body pieces and webs, the yield point of the material of the webs is to be not less than 14 tons per square inch, and the shrinkage allowance is to be between $\frac{1}{550}$ and $\frac{1}{700}$ of the diameter of the shaft.

5. **Intermediate Shafts.**—The diameter of the intermediate shafts is not to be less than that given by the formulæ :—

$$\left.\begin{array}{r}\text{For engines having a maximum}\\ \text{pressure under 350 lb. per}\\ \text{square inch. Diameter of}\\ \text{intermediate shaft, in inches}\end{array}\right\} = C\sqrt[3]{\frac{B.H.P.}{R}}$$

(Table II.)

$$\left.\begin{array}{r}\text{For engines having a maximum}\\ \text{pressure of 350 and under}\\ \text{500 lb. per square inch. Dia-}\\ \text{meter of intermediate shaft,}\\ \text{in inches}\end{array}\right\} = C\sqrt[3]{\frac{B.H.P.}{R}}$$

(Table III.)

$$\left.\begin{array}{r}\text{For engines having a maximum}\\ \text{pressure of 500 to 700 lb. per}\\ \text{square inch. Diameter of}\\ \text{intermediate shaft, in inches}\end{array}\right\} = C\sqrt[3]{\frac{B.H.P.}{R}}$$

(Table IV.)

where **B.H.P.** = designed maximum brake horse power,

R = revolutions of engines per minute,

C is a coefficient found from **Tables II.** or **III.**, by interpolation from the values found for **A**, or from **Table IV.** by interpolation from the values found for **A** and the piston speeds.

In using **Tables II., III.** and **IV.** the appropriate value of **A** is found thus :—

$$A = \frac{D^2 \times S}{W \times d^2 \times R^2}$$

where **D** = diameter of cylinder, in inches,

S = length of stroke, in inches,

d = diameter of fly wheel, in feet,

R = revolutions of engines per minute,

W = total weight of fly wheel, in tons.

Where a fly wheel is not fitted, but where there are special balance weights at the crank webs, the value of **A** may be found from the formula :—

$$A = \frac{D^2 \times S}{6{\cdot}24 \times w \times r^2 \times R^2}$$

where **D** = diameter of cylinder, in inches,

S = length of stroke, in inches,

r = radius of gyration of balance weights, in feet,

R = revolutions of engines per minute,

w = total weight of balance weights, in tons.

Where a flywheel and special balance weights are fitted, the value of **A** may be found from the formula :—

$$A = \frac{D^2 \times S}{(6{\cdot}24 \times wr^2 + Wd^2) \times R^2}$$

6. **Fly Wheel Shaft.**—The diameter of the fly wheel shaft is to be at least equal to that of the crank shaft.

7. **Thrust Shafts.**—The diameter at the collars of thrust shafts transmitting torque is not to be less than 1·05 times that required for the intermediate shaft. Thrust shafts may be tapered down outside the collars to the diameter required for the intermediate shaft.

8. **Tube Shafts** (Shafts passing through stern tubes but not carrying the screw propellers).—The diameter of the tube shaft is not to be less than 1·05 times that required for the intermediate shaft, and any part of the shaft within the tube which may be exposed to sea water is not to be less than 1·075 times that required for the intermediate shaft.

9. **Screw Shafts** (Shafts carrying the screw propellers).—(*a*) The diameter of the screw shaft is not to be less than that given by the following formula :—

$$\text{Diameter of screw shaft, in inches or millimetres} = d + \frac{P}{C}$$

where d is the diameter required for the intermediate shafts, in inches or millimetres,

P is the diameter of the propeller, in inches or millimetres,

C = 144 when the shaft is fitted with a continuous liner, or

C = 100 when the shaft is not fitted with a continuous liner.

(*b*) Screw shafts which run in stern tubes may have the end forward of the stern gland tapered down to a diameter, at the coupling flange, of 1·05 times d.

(*c*) Screw shafts for ships intended to have the notation "Strengthened for Navigation in Ice," are to comply with the requirements of **Section 40, clause 5**, of **Rules for Steel Ships.**

10. **Bronze Liners on Shafts.**—(*a*) The thickness of liners fitted on screw shafts or on tube shafts, in way of the bushes, is not to be less than that given by the following formulæ :—

$$t = \frac{d + 9{\cdot}25}{32} \quad \text{or} \quad t_m = \frac{+ 235}{32}$$

where t is the thickness of the liner, in inches,

t_m is the thickness of the liner, in millimetres,

d is the diameter required for the screw or tube shaft under the liner, in inches or millimetres.

(*b*) The thickness of a continuous liner between the bushes is not to be less than $\frac{3}{4}t$ or $\frac{3}{4}t_m$.

(*c*) Continuous liners should be cast in one piece, or, if made of two or more lengths, the junctions of the separate pieces are to be made by fusion through the whole thickness of the liner.

(*d*) Liners are to be carefully shrunk on, or forced on to the shafts by hydraulic pressure. Pins are not to be used to secure the liners.

(*e*) If the liner does not fit tightly between the bearings in the stern tube, the space between the shaft and the liner is to be charged or forced with a plastic material insoluble in water and non-corrosive.

(*f*) Effective means are to be provided for preventing water from having access to the shaft at the part between the after end of the liner and the propeller boss.

11. **Stern Bush.**—The length of the bearing in the stern bush next to and supporting the propeller, is not to be less than 4 times the diameter required for the screw shaft under the liner.

12. **Couplings.**—(*a*) The diameter of the coupling bolts at the joining faces of the couplings is not to be less than that given by the following formula :—

$$\text{Diameter of coupling bolts, in inches or millimetres...} = \sqrt{\frac{d^3}{3{\cdot}5 \times n \times r}}$$

where d is the diameter required for the intermediate shafts, in inches or millimetres,

n is the number of bolts in the coupling,

r is the radius of the pitch circle of the bolts, in inches or millimetres,

(*b*) The thickness of the coupling flanges at the pitch circle of the bolt holes is not to be less than the diameter of the coupling bolts, at the face of the coupling. The thickness of the screw shaft coupling flange is not to be less than ·25 of the diameter required for the intermediate shaft.

(*c*) The radius of the curvature at the fillet where the flange starts from the shaft, should not be less than ·125 times the diameter of the shaft adjacent to the flange.

(*d*) Where couplings are separate from the shafts, provision is to be made to resist the astern pull.

13. **Bronze Propellers.**—Where bronze is used for propellers or propeller blades, it is to comply with the requirements of **Section 11** of the **Rules for Quality and Testing of Materials.**

TABLE I. FOR CRANK SHAFTS OF SINGLE ACTING ENGINES.

4 Cycle Single Acting Engines. — Number of Cylinders.	2 Cycle Single Acting Engines. — Number of Cylinders.	Values of Coefficients.									
		Maximum Pressure 300 lb. per sq. inch.				Maximum Pressure 400 lb. per sq. inch.					
		M.I.P. 40 lb. per sq. inch.		M.I.P. 60 lb. per sq. inch.		M.I.P. 40 lb. per sq. inch.		M.I.P. 60 lb. per sq. inch.		M.I.P. 80 lb. per sq. inch.	
		A	B	A	B	A	B	A	B	A	B
1, 2, 3 or 4	1 or 2	·017	·031	·026	·031	·013	·062	·025	·058	·036	·054
5 or 6	3	·027	·028	·036	·028	·025	·058	·038	·054	·050	·050
7 or 8	4	·028	·028	·040	·028	·026	·058	·040	·054	·061	·048
9 or 10	5	·030	·027	·044	·027	·028	·056	·048	·051	·068	·047
11 or 12	6	·031	·027	·045	·027	·027	·058	·051	·051	·070	·046
—	7	·033	·027	·049	·027	·034	·054	·058	·049	·076	·045
—	8	·036	·027	·053	·027	·038	·054	·064	·048	·079	·045
—	9	·041	·026	·058	·026	·043	·051	·070	·046	·090	·042
—	10	·045	·024	·065	·024	·045	·051	·072	·046	·099	·041
—	11	·044	·026	·064	·026	·046	·053	·074	·046	·104	·041
—	12	·045	·026	·067	·026	·047	·053	·076	·046	·109	·040
—	4 2 Firing together.	·040	·026	·057	·026	·036	·054	·059	·049	·085	·043
—	6 2 Firing together.	·045	·024	·061	·024	·041	·053	·069	·046	·093	·042
—	8 2 Firing together.	·064	·022	·086	·022	·060	·049	·096	·043	·133	·038
—	10 2 Firing together.	·071	·022	·094	·022	·074	·046	·112	·040	·142	·037
—	12 2 Firing together.	·065	·022	·091	·022	·073	·046	·112	·040	·147	·037

TABLE I.—*continued.* FOR CRANK SHAFTS OF SINGLE ACTING ENGINES.

4 Cycle Single Acting Engines. Number of Cylinders.	2 Cycle Single Acting Engines. Number of Cylinders.	Values of Coefficients. Maximum Pressure 500 to 700 lb. per sq. inch.													
		M.I.P. 40 lb. per sq. inch.		M.I.P. 60 lb. per sq. inch.		M.I.P. 80 lb. per sq. inch.		M.I.P. 100 lb. per sq. inch.		M.I.P. 120 lb. per sq. inch.		M.I.P. 140 lb. per sq. inch.		M.I.P. 160 lb. per sq. inch.	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B
1,2,3 or 4	1 or 2	·030	·067	·046	·067	·061	·067	·076	·067	·089	·067	·099	·067	·108	·067
5 or 6	3	·042	·064	·059	·064	·070	·064	·082	·064	·096	·064	·111	·064	·120	·064
7 or 8	4	·045	·062	·062	·062	·079	·062	·092	·062	·110	·062	·127	·062	·143	·062
9 or 10	5	·047	·061	·064	·061	·082	·061	·101	·061	·121	·061	·135	·061	·150	·061
11 or 12	6	·049	·061	·066	·061	·084	·061	·103	·061	·123	·061	·137	·061	·153	·061
—	7	·051	·061	·068	·061	·086	·061	·106	·061	·125	·061	·140	·061	·156	·061
—	8	·053	·061	·070	·061	·088	·061	·109	·061	·128	·061	·148	·061	·165	·061
—	9	·059	·058	·080	·058	·101	·058	·122	·058	·144	·058	·163	·058	·181	·058
—	10	·064	·057	·088	·057	·112	·057	·134	·057	·157	·057	·178	·057	·198	·057
—	11	·066	·056	·091	·056	·115	·056	·139	·056	·161	·056	·182	·056	·203	·056
—	12	·069	·056	·093	·056	·119	·056	·147	·056	·178	·056	·202	·056	·223	·056
—	4 2 Firing together.	·076	·054	·105	·054	·136	·054	·160	·054	·183	·054	·206	·054	·232	·054
—	6 2 Firing together.	·078	·053	·107	·053	·140	·053	·164	·053	·187	·053	·210	·053	·237	·053
—	8 2 Firing together.	·097	·050	·133	·050	·170	·050	·203	·050	·229	·050	·258	·050	·292	·050
—	10 2 Firing together.	·107	·049	·141	·049	·175	·049	·208	·049	·242	·049	·268	·049	·303	·049
—	12 2 Firing together.	·090	·051	·126	·051	·161	·051	·196	·051	·222	·051	·248	·051	·286	·051

TABLE II. FOR INTERMEDIATE SHAFTS OF SINGLE ACTING ENGINES.

MAXIMUM PRESSURE UNDER 350 LB. PER SQ. INCH.							
4 CYCLE SINGLE ACTING ENGINES. — NUMBER OF CYLINDERS.	2 CYCLE SINGLE ACTING ENGINES. — NUMBER OF CYLINDERS.	VALUES OF COEFFICIENT C WHERE					
		A = ·0015	A = ·0025	A = ·005	A = ·010	A = ·015	NO FLY WHEEL OR BALANCE WEIGHTS.
1 or 2	1	4·26	4·48	5·02	5·92	—	—
3 or 4	2	4·17	4·20	4·25	4·38	4·55	5·96
5 or 6	3	4·15	4·17	4·20	4·26	4·35	4·90
7 or 8	4	4·10	4·13	4·16	4·24	4·32	4·77
9 or 10	5	4·07	4·07	4·09	4·14	4·18	4·34
11 or 12	6	4·06	4·06	4·06	4·08	4·10	4·18
—	7	4·05	4·05	4·05	4·06	4·06	4·09
—	8	4·04	4·04	4·04	4·04	4·04	4·04
—	9	4·03	4·03	4·03	4·03	4·03	4·03
—	10	4·03	4·03	4·03	4·03	4·03	4·03
—	11	4·02	4·02	4·02	4·02	4·02	4·02
—	12	4·02	4·02	4·02	4·02	4·02	4·02
—	4 2 Firing together.	4·13	4·20	4·38	4·67	4·87	5·85
—	6 2 Firing together.	4·12	4·19	4·32	4·50	4·63	5·13
—	8 2 Firing together.	4·10	4·15	4·24	4·36	4·43	4·70
—	10 2 Firing together.	4·07	4·10	4·15	4·22	4·27	4·39
—	12 2 Firing together.	4·04	4·05	4·08	4·11	4·12	4·16

TABLE III. FOR INTERMEDIATE SHAFTS OF SINGLE ACTING ENGINES.

MAXIMUM PRESSURE 350 AND UNDER 500 LB. PER SQ. INCH.

4 Cycle Single Acting Engines. — Number of Cylinders.	2 Cycle Single Acting Engines. — Number of Cylinders.	Values of coefficient C where					
		A = ·0015	A = ·0025	A = ·005	A = ·010	A = ·015	No fly wheel or balance weights.
1 or 2	1	4·33	4·59	5·23	6·31	—	—
3 or 4	2	4·19	4·24	4·34	4·59	4·83	6·67
5 or 6	3	4·16	4·18	4·22	4·32	4·42	5·08
7 or 8	4	4·10	4·14	4·18	4·30	4·40	4·90
9 or 10	5	4·07	4·08	4·11	4·17	4·21	4·42
11 or 12	6	4·06	4·06	4·08	4·11	4·13	4·23
—	7	4·05	4·05	4·06	4·08	4·10	4·16
—	8	4·04	4·04	4·04	4·04	4·04	4·06
—	9	4·03	4·03	4·03	4·03	4·03	4·03
—	10	4·03	4·03	4·03	4·03	4·03	4·03
—	11	4·02	4·02	4·02	4·02	4·02	4·02
—	12	4·02	4·02	4·02	4·02	4·02	4·02
—	4 2 Firing together.	4·19	4·29	4·59	5·00	5·26	6·55
—	6 2 Firing together.	4·18	4·23	4·41	4·66	4·81	5·41
—	8 2 Firing together.	4·12	4·18	4·28	4·43	4·51	4·80
—	10 2 Firing together.	4·10	4·12	4·18	4·27	4·31	4·43
—	12 2 Firing together.	4·05	4·07	4·10	4·14	4·15	4·20

TABLE IV. FOR INTERMEDIATE SHAFTS OF SINGLE ACTING ENGINES.

MAXIMUM PRESSURE 500 TO 700 LB. PER SQ. INCH.

2 CYCLE SINGLE ACTING ENGINES.

NUMBER OF CYLINDERS.	VALUES OF A.	Values of Coefficient C for the following Piston Speeds in feet per Minute. 700 and below.	850	1000	1200 and above.
1 or 2	·0015	4·45	4·41	4·39	4·37
	·0025	4·75	4·70	4·64	4·58
	·005	5·40	5·26	5·11	4·96
3	·0015	4·22	4·21	4·20	4·18
	·0025	4·37	4·33	4·29	4·26
	·005	4·70	4·55	4·49	4·40
	·010	5·14	4·88	4·69	4·54
4	·0015	4·14	4·13	4·12	4·11
	·0025	4·22	4·19	4·17	4·15
	·005	4·38	4·31	4·25	4·21
	·010	4·61	4·47	4·33	4·26
	·015	4·75	4·52	4·38	4·28
5	·0015	4·07	4·07	4·07	4·05
	·0025	4·11	4·09	4·09	4·07
	·005	4·18	4·15	4·11	4·09
	·010	4·28	4·21	4·14	4·10
	·015	4·33	4·24	4·16	4·11
	No Fly Wheel or Balance Weights.	4·47	4·32	4·21	4·13
6	·0015 to ·010	4·06	4·06	4·06	4·06
	·015	4·10	4·06	4·06	4·06
	No Fly Wheel or Balance Weights.	4·15	4·06	4·06	4·06
7	All Values including No Fly Wheel or Balance Weights.	4·05	4·05	4·05	4·05
8	,,	4·04	4·04	4·04	4·04
9	,,	4·03	4·03	4·03	4·03
10	,,	4·03	4·03	4·03	4·03
11	,,	4·02	4·02	4·02	4·02
12	,,	4·02	4·02	4·02	4·02
4 2 Firing together.	·0015	4·87	4·78	4·70	4·63
	·0025	5·35	5·18	5·02	4·87
	·005	6·16	5·77	5·45	5·19
6 2 Firing together.	·0015	4·43	4·37	4·30	4·26
	·0025	4·66	4·54	4·46	4·36
	·005	5·06	4·79	4·61	4·48
	·010	5·41	5·02	4·74	4·55
8 2 Firing together.	·0015	4·24	4·20	4·17	4·15
	·0025	4·32	4·27	4·22	4·18
	·005	4·53	4·38	4·27	4·21
	·010	4·70	4·48	4·32	4·24
	·015	4·78	4·50	4·34	4·25
	No Fly Wheel or Balance Weights.	4·99	4·60	4·39	4·27
10 2 Firing together.	·0015	4·12	4·09	4·08	4·07
	·0025	4·16	4·13	4·10	4·08
	·005	4·24	4·18	4·13	4·08
	·010	4·32	4·21	4·15	4·10
	·015	4·35	4·22	4·16	4·10
	No Fly Wheel or Balance Weights.	4·42	4·25	4·17	4·12
12 2 Firing together.	·0015 to ·005	4·06	4·05	4·04	4·03
	·010, ·015 and No Fly Wheel or Balance Weights.	4·11	4·06	4·05	4·04

4 CYCLE SINGLE ACTING ENGINES.

NUMBER OF CYLINDERS.	VALUES OF A.	Values of Coefficient C for the following Piston Speeds in feet per Minute. 700 and below.	850	1000	1200 and above.
1, 2, 3 or 4	·0015	4·40	4·36	4·33	4·29
	·0025	4·66	4·59	4·50	4·45
	·005	5·16	4·95	4·78	4·64
	·010	5·72	5·34	5·05	4·81
5	·0015	4·27	4·26	4·23	4·21
	·0025	4·42	4·38	4·33	4·27
	·005	4·77	4·61	4·48	4·38
	·010	5·10	4·83	4·61	4·48
6	·0015	4·20	4·18	4·16	4·14
	·0025	4·30	4·26	4·22	4·19
	·005	4·52	4·40	4·30	4·24
	·010	4·75	4·53	4·38	4·28
	·015	4·88	4·60	4·43	4·30
	No Fly Wheel or Balance Weights.	5·27	4·78	4·52	4·35
7	·0015	4·17	4·14	4·13	4·12
	·0025	4·24	4·21	4·18	4·16
	·005	4·36	4·30	4·23	4·19
	·010	4·53	4·36	4·28	4·21
	·015	4·63	4·40	4·30	4·22
	No Fly Wheel or Balance Weights.	4·87	4·52	4·34	4·24
8	·0015	4·13	4·11	4·10	4·08
	·0025	4·18	4·15	4·12	4·10
	·005	4·27	4·21	4·16	4·13
	·010	4·37	4·25	4·19	4·14
	·015	4·43	4·27	4·20	4·15
	No Fly Wheel or Balance Weights.	4·58	4·34	4·23	4·17
9	·0015	4·10	4·09	4·08	4·07
	·0025	4·14	4·11	4·10	4·08
	·005	4·20	4·16	4·12	4·10
	·010	4·26	4·18	4·13	4·11
	·015	4·29	4·19	4·14	4·11
	No Fly Wheel or Balance Weights.	4·37	4·23	4·17	4·12
10	·0015 to ·015	4·13	4·09	4·06	4·06
	No Fly Wheel or Balance Weights.	4·22	4·14	4·10	4·06
11	All Values including No Fly Wheel or Balance Weights.	4·07	4·07	4·07	4·07
12	,,	4·05	4·05	4·05	4·05

DOUBLE ACTING ENGINES.

Rules for Determining Sizes of Shafts.

Section 4. 1.—(*a*) The crank, intermediate and other shafts, if of ordinary mild steel having a tensile breaking strength of 28–32 tons per square inch, are to be of not less diameters than those given by the following formulæ.

The formulæ do not, however, take into consideration the possibility of severe torsional vibration stresses arising in the shafting.

Calculations of the torsional vibration characteristics for the dynamic system formed by the engine, shafting and propeller, also gearing or generators where these are interposed, are to be submitted for consideration, together with plans of all shafting. These calculations should include frequency tables for the one and two node natural frequencies, also three node where necessary, and particulars of the firing order. In drawing up frequency tables, the single amplitude of swing should be taken as one radian at the first mass at the end of the engine remote from the driving end. The vector summations are to be given for the relative angular displacements of the working cranks for all orders of vibration occurring at speeds less than 30 per cent. above the normal running speed.

Similar calculations are to be submitted for heavy oil engines of 100 B.H.P. or more driving auxiliary machinery used for essential services at sea.

In certain cases the Committee may consider it necessary for torsiograph readings to be taken from the machinery after fitting on board, for the purpose of verifying that serious critical speeds do not occur within the range of working speeds.

(*b*) Where shafts are proposed to be made of special high tensile steel, their sizes should be submitted for consideration.

2. **Crank Shafts.**—Where the designed maximum and mean indicated pressures are 500 and 100 lb. per square inch respectively, the diameter of the crankshaft of the main engines is not to be less than that given by the following formula :—

$$\left.\begin{array}{l}\text{Diameter of crank}\\ \text{shaft, in inches}\\ \text{or millimetres}\end{array}\right\} = \sqrt[3]{D^2 \times (AS + BL)}$$

where **D** = diameter of cylinder, in inches or millimetres,
S = length of stroke, in inches or millimetres,
L = span of bearings adjacent to a crank, measured from inner edge to inner edge, in inches or millimetres.
A and **B** are coefficients found from **Table V.**

Where the designed maximum and mean indicated pressures are other than 500 and 100 lb. per square inch respectively, or where special arrangements of cranks and firing orders are adopted, also where balance weights are fitted to the crank webs and only light flywheels are fitted, the sizes of the shafting will be specially considered.

For heavy oil engines, with not more than three cylinders, driving auxiliary machinery the diameters of the crankshafts may be five per cent less than given by the foregoing formula.

3. **Crank Webs of Solid Forged Shafts.**—In solid forged shafts the breadth of the webs should not be less than 1·33 times and the thickness not less than ·56 times the diameter of the shaft as found by the foregoing formula, or, if these proportions are departed from, the webs are to be of equivalent strength.

4. **Crank Webs of Built Shafts.**—(*a*) The dimensions of the crank webs of built shafts are not to be less than those given by the following formulæ :—

$$h = \cdot 625 \times d$$

$$t = \sqrt{\frac{\cdot 12 \times d^3}{h}}$$

where h is the thickness of the web, measured parallel to the axis, in inches or millimetres,
t is the thickness of metal around the eyeholes, measured radially, in inches or millimetres,
d is the diameter required for the crank shaft, in inches or millimetres.

(*b*) Crank webs are to be securely shrunk on the body pieces and crank pins. If dowels are not fitted at the junction of the body pieces and webs, the yield point of the material of the webs is to be not less than 14 tons per square inch, and the shrinkage allowance is to be between $\frac{1}{350}$ and $\frac{1}{700}$ of the diameter of the shaft.

5. **Intermediate Shafts.**—Where the designed maximum pressure does not exceed 500 lb. per square inch, the diameter of the intermediate shaft is to be not less than that given by the formula :—

$$\left.\begin{array}{l}\text{Diameter of intermediate shaft,}\\ \text{in inches} \quad \ldots\end{array}\right\} = C \sqrt[3]{\frac{B.H.P.}{R}}$$

Where **B.H.P.** = Designed maximum brake horse power,
R = Revolutions of engines per minute,
C is a coefficient found from **Table VI.** by interpolation from the values found for **A** and the piston speeds.

In using **Table VI.** the appropriate value of **A** is found thus :—

$$A = \frac{D^2 \times S}{W \times d^2 \times R^2}$$

where **D** = diameter of cylinder, in inches,
S = length of stroke, in inches,
d = diameter of fly wheel, in feet,
R = revolutions of engines per minute,
W = total weight of fly wheel, in tons.

Where a fly wheel is not fitted, but where there are special balance weights at the crank webs, the value of **A** may be found from the formula :—

$$A = \frac{D^2 \times S}{6{\cdot}24 \times w \times r^2 \times R^2}$$

where **D** = diameter of cylinder, in inches,
S = length of stroke, in inches,
r = radius of gyration of balance weights, in feet,
R = revolutions of engines per minute,
w = total weight of balance weights, in tons.

Where a fly wheel and special balance weights are fitted the value of **A** may be found from the formula :—

$$A = \frac{D^2 \times S}{(6{\cdot}24 \times wr^2 + Wd^2) \times R^2}$$

TABLE V. FOR CRANK SHAFTS OF DOUBLE ACTING ENGINES.

500 LB. PER SQ. INCH MAXIMUM PRESSURE AND 100 LB. PER SQ. INCH MEAN INDICATED PRESSURE (TOP AND BOTTOM).

2 Cycle Double Acting Engines.				4 Cycle Double Acting Engines.				
Number of Cylinders.	Arrangement of Cranks.	Values of Coefficients.		Number of Cylinders.	Arrangement of Cranks.	Particulars of Firing.	Values of Coefficients.	
		A	B				A	B
1	—	·063	·044	1	—	—	·063	·044
2	—	·104	·038	2	—	—	·104	·038
3	—	·076	·042	3	—	—	·094	·039
4		·116	·037	4	—	—	·159	·034
4		·159	·034	6		No Simultaneous Firing.	·127	·037
5		·127	·036	8		Two Cylinder Ends Fire together.	·200	·032
6		·141	·035	6		Two Cylinder Ends Fire together.	·185	·032
6		·152	·034	8		Four Cylinder Ends Fire together.	·355	·028
7		·149	·034					
8		·189	·032					
9		·196	·032					
6		·167	·033					
8		·324	·028					

TABLE VI. FOR INTERMEDIATE SHAFTS OF DOUBLE ACTING ENGINES.

500 LB. PER SQ. INCH MAXIMUM PRESSURE.

2 Cycle Double Acting Engines.						4 Cycle Double Acting Engines.					
Number of Cylinders.	Values of A.	Values of Coefficient C for the following Piston Speeds in Feet per Minute.				Number of Cylinders.	Values of A.	Values of Coefficient C for the following Piston Speeds in Feet per Minute.			
		700 and below.	850	1000	1200 and above.			700 and below.	850	1000	1200 and above.
1	·0015	4·48	4·47	4·46	4·44	1	·0015	4·59	4·57	4·55	4·52
	·0025	4·82	4·79	4·75	4·71		·0025	5·01	4·96	4·91	4·85
2 Cranks at 90°	·0015	4·21	4·20	4·19	4·18	2 Cranks at 90°	·0015	4·54	4·52	4·47	4·44
	·0025	4·35	4·31	4·28	4·26		·0025	4·89	4·81	4·73	4·64
	·005	4·68	4·58	4·50	4·43						
	·010	5·15	4·92	4·74	4·59						
2 Cranks at 180°	·0015	4·69	4·65	4·61	4·57	2 Cranks at 180°	·0015	4·97	4·91	4·85	4·78
	·0025	5·14	5·06	4·95	4·86		·0025	5·54	5·41	5·27	5·15
3	·0015	4·11	4·11	4·10	4·09	3	·0015	4·53	4·48	4·45	4·39
	·0025	4·17	4·16	4·14	4·13		·0025	4·86	4·75	4·65	4·56
	·005	4·30	4·25	4·21	4·18		·005	5·45	5·20	4·98	4·80
	·010	4·50	4·37	4·28	4·22						
	·015	4·62	4·47	4·32	4·25						
	No Fly Wheel or Balance Weights	5·15	4·70	4·47	4·31						
4	·0015	4·20	4·18	4·16	4·15	4	·0015	4·69	4·61	4·53	4·47
	·0025	4·30	4·26	4·22	4·19		·0025	5·11	4·89	4·74	4·62
	·005	4·53	4·41	4·31	4·25		·005	5·65	5·24	5·03	4·81
	·010	4·78	4·56	4·40	4·30						
	·015	4·91	4·63	4·47	4·32						
	No Fly Wheel or Balance Weights	5·35	4·84	4·55	4·38						
5	·0015 to ·0025	4·05	4·04	4·04	4·04	6 No Simultaneous Firing.	·0015	4·09	4·08	4·07	4·06
	·005 to ·015	4·10	4·07	4·06	4·05		·0025	4·13	4·10	4·09	4·07
	No Fly Wheel or Balance Weights	4·16	4·10	4·07	4·06		·005	4·18	4·14	4·11	4·08
6	·0015 to ·0025	4·06	4·05	4·04	4·04		·010	4·23	4·17	4·12	4·09
	·005 to ·015	4·12	4·09	4·07	4·05		·015	4·26	4·18	4·13	4·10
	No Fly Wheel or Balance Weights	4·16	4·11	4·08	4·06		No Fly Wheel or Balance Weights	4·34	4·21	4·14	4·11
7	All Values, including No Fly Wheel or Balance Weights.	4·04	4·04	4·04	4·04	8 2 Cylinder Ends Fire together.	·0015	4·15	4·13	4·10	4·08
							·0025	4·20	4·16	4·13	4·10
							·005	4·28	4·20	4·15	4·12
							·010	4·35	4·23	4·17	4·13
							·015	4·38	4·24	4·18	4·13
							No Fly Wheel or Balance Weights	4·48	4·27	4·19	4·14
8	,,	4·03	4·03	4·03	4·03						
9	,,	4·02	4·02	4·02	4·02						
6 	·0015	4·19	4·17	4·15	4·13	6  2 Cylinder Ends Fire together.	·0015	4·92	4·78	4·65	4·53
	·0025	4·27	4·23	4·19	4·16		·0025	5·31	5·06	4·84	4·67
	·005	4·45	4·31	4·24	4·19						
	·010	4·60	4·40	4·28	4·21						
	·015	4·68	4·46	4·30	4·22						
	No Fly Wheel or Balance Weights	4·91	4·54	4·35	4·25						
8 	·0015	4·32	4·26	4·21	4·18	8  4 Cylinder Ends Fire together.	·0015	5·07	4·84	4·67	4·53
	·0025	4·47	4·34	4·26	4·21		·0025	5·39	5·07	4·80	4·62
	·005	4·64	4·46	4·31	4·23						
	·010	4·80	4·52	4·35	4·25						
	·015	4·86	4·55	4·37	4·26						
	No Fly Wheel or Balance Weights	5·03	4·62	4·40	4·28						

6. **Fly Wheel Shaft.**—The diameter of the fly wheel shaft is to be at least equal to that of the crank shaft.

7. **Thrust Shafts.**—The diameter at the collars of thrust shafts transmitting torque is not to be less than 1·05 times that required for the intermediate shaft. Thrust shafts may be tapered down outside the collars to the diameter required for the intermediate shaft.

8. **Tube Shafts** (Shafts passing through stern tubes but not carrying the screw propellers).—The diameter of the tube shaft is not to be less than 1·05 times that required for the intermediate shaft, and any part of the shaft within the tube which may be exposed to sea water is not to be less than 1·075 times that required for the intermediate shaft.

9. **Screw Shafts** (Shafts carrying the screw propellers).—(*a*) The diameter of the screw shaft is not to be less than that given by the following formula:—

$$\text{Diameter of screw shaft, in inches or millimetres} = d + \frac{P}{C}$$

where d is the diameter required for the intermediate shafts, in inches or millimetres,

P is the diameter of the propeller, in inches or millimetres,

C = 144 when the shaft is fitted with a continuous liner, or

C = 100 when the shaft is not fitted with a continuous liner.

(*b*) Screw shafts which run in stern tubes may have the end forward of the stern gland tapered down to a diameter, at the coupling flange, of 1·05 times d.

(*c*) Screw shafts for ships intended to have the notation "Strengthened for Navigation in Ice," are to comply with the requirements of **Section 40, clause 5, of Rules for Steel Ships.**

10. **Bronze Liners on Shafts.**—(*a*) The thickness of liners fitted on screw shafts or on tube shafts, in way of the bushes, is not to be less than that given by the following formulæ:—

$$t = \frac{d + 9{\cdot}25}{32} \qquad \text{or} \qquad t_m = \frac{d + 235}{32}$$

where t is the thickness of the liner, in inches,

t_m is the thickness of the liner, in millimetres,

d is the diameter required for the screw or tube shaft under the liner, in inches or millimetres.

(*b*) The thickness of a continuous liner between the bushes is not to be less than $\frac{3}{4}t$ or $\frac{3}{4}t_m$.

(*c*) Continuous liners should be cast in one piece, or if made of two or more lengths, the junctions of the separate pieces are to be made by fusion through the whole thickness of the liner.

(*d*) Liners are to be carefully shrunk on, or forced on to the shafts by hydraulic pressure. Pins are not to be used to secure the liners.

(*e*) If the liner does not fit tightly between the bearings in the stern tube, the space between the shaft and the liner is to be charged or forced with a plastic material insoluble in water and non-corrosive.

(*f*) Effective means are to be provided for preventing water from having access to the shaft at the part between the after end of the liner and the propeller boss.

11. **Stern Bush.**—The length of the bearing in the stern bush next to and supporting the propeller, is not to be less than 4 times the diameter required for the screw shaft under the liner.

12. **Couplings.**—(*a*) The diameter of the coupling bolts at the joining faces of the couplings is not to be less than that given by the following formula:—

$$\left.\begin{array}{l}\text{Diameter of coupling bolts,}\\ \text{in inches or millimetres...}\end{array}\right\} = \sqrt{\frac{d^3}{3{\cdot}5 \times n \times r}}$$

where d is the diameter required for the intermediate shafts, in inches or millimetres,

n is the number of bolts in the coupling,

r is the radius of the pitch circle of the bolts, in inches or millimetres.

(*b*) The thickness of the coupling flanges at the pitch circle of the bolt holes is not to be less than the diameter of the coupling bolts, at the face of the coupling. The thickness of the screw shaft coupling flange is not to be less than ·25 of the diameter required for the intermediate shaft.

(*c*) The radius of the curvature at the fillet where the flange starts from the shaft, should not be less than ·125 times the diameter of the shaft adjacent to the flange.

(*d*) Where couplings are separate from the shafts, provision is to be made to resist the astern pull.

13. **Bronze Propellers.**—Where bronze is used for propellers or propeller blades, it is to comply with the requirements of **Section 11** of the **Rules for Quality and Testing of Materials.**

GENERAL REQUIREMENTS FOR SINGLE AND DOUBLE ACTING ENGINES.

Section 5. 1. Cylinder liners are to be tested internally by hydraulic pressure, over their whole length; the pressure is to be not less than 100 lb. per square inch applied for a period of not less than 30 minutes.

2. The water jackets of the cylinders, and the water passages of the cylinder covers and pistons, are to be tested by hydraulic pressure to 30 lb. per square inch.

3. The exhaust pipes and silencer are to be efficiently water cooled or lagged to prevent damage by heat, and if the exhaust is led overboard near the water-line, means are to be provided to prevent water from being syphoned back to the engine.

4. The cylinders are to be fitted with safety valves loaded to not more than 40 per cent above the designed maximum pressure in the cylinders and discharging where no damage can occur.

Cylinders not exceeding 6 inches diameter need not be fitted with safety valves.

Where compressed air is not used for starting purposes safety valves need not be fitted on cylinders not exceeding 8 inches diameter.

5. The air compressors and their coolers are to be so made as to be easy of access for overhaul and adjustment and each compressor is to be fitted with a safety valve adjusted to the maximum working pressure.

6. Where the fuel is injected into the cylinders by air pressure, one main air compressor should be provided for each main engine.

In single screw vessels, an auxiliary air compressor is to be provided of sufficient capacity to enable the engines to be kept at work at not less than two-thirds of the normal sea power.

In twin screw vessels where two sets of compressors are fitted, the auxiliary compressor is to be of sufficient capacity to enable one main engine to be kept at work at not less than two-thirds of its normal sea power. If in such engines each main compressor is sufficiently large to supply both engines, a smaller auxiliary compressor will be sufficient.

7. A small auxiliary compressor, which does not require compressed air for starting up, is to be fitted for first charging the air receivers.

8. At least one high pressure air receiver is to be arranged with connections to enable it to be used for fuel injection, in case the working receiver of either main engine is out of use from any cause.

9. Where only one scavenging blower is fitted, alternative or duplicate means for driving the blower are to be provided ready for use.

10. Where sea water is used for cooling the main and/or auxiliary engine cylinders, the water circulating pump sea suctions, both main and auxiliary, are to be provided with efficient strainers which can be cleared inside the vessel.

11. In all vessels an additional water circulating pump is to be fitted and connected ready for immediate use.

Not less than two sea suctions are to be provided for the pumps supplying circulating water for the main engines, fresh water coolers and oil coolers, one suction for the main pump and one for the stand-by pump.

These suctions are to be low suctions, and one of them may be the ballast pump sea suction.

12. In ocean-going vessels fitted with engines over 350 BHP in which the lubricating oil is circulated under pressure, two lubricating oil pumps are to be fitted and connected ready for immediate use, each pump being of sufficient capacity for normal power. Where an oil cooler is fitted, the supply of cooling water may be taken from the main engine cooling water system, or alternatively the water is to be supplied by two pumps each of adequate capacity for normal power. One of these pumps may be a ballast or general service pump.

13. Where the lubricating oil for main engines is circulated under pressure, provision is to be made for efficiently straining the oil. Where strainers are on the discharge side of the oil pump a relief valve, in close circuit, is to be fitted between the pump and the strainer.

The strainers or filters are to be capable of being cleaned without stopping the oil supply to the engines.

14. Engines intended for driving electric generators are to comply with the requirements of the **Rules for Electric Propelling Machinery, Section 4,** and of the **Rules for Electrical Equipment, Section 2, clauses 1, 12, 16** and **17** where these are applicable.

AIR RECEIVERS AND PIPES.

Section 6. 1. Compressed air receivers for starting air are to be supplied of sufficient capacity to permit of twelve consecutive startings of each main engine without replenishment.

2. Cylindrical receivers for containing air under high pressure, used either for starting or for the injection of fuel in oil engines, may be made either of seamless steel or of welded, or riveted, steel plates.

3. **Welded Receivers.**—Receivers of fusion or forge welded construction are to comply with the **Rules for Welded Pressure Vessels.**

4. **Riveted Receivers.**—Receivers of riveted construction are to comply with the **Rules for Cylindrical Boilers,** but where end plates are dished to partial spherical form, subject to pressure on the concave side, and not fitted with stays, the following formula may be used:—

$$WP = \frac{576 \times S \times T}{R}$$

where T = thickness of the end in inches after dishing,

WP = working pressure in lb. per square inch.

R = inside radius of curvature of the end in inches, which is not to exceed the diameter of the shell.

S = ultimate tensile strength of the plates in tons per square inch.

The inside corner radius is not to be less than four times the thickness of the end plate and in no case less than 2·5 inches.

Where the end is provided with a flanged manhole the thickness of the end in inches determined by the foregoing formula is to be increased by $\frac{1}{8}$ inch and the depth of the manhole flange, measured in inches from the outer surface at the minor axis shall be not less than $F = \sqrt{T_1 \times W}$

where T_1 = the required thickness of the end plate in inches.

W = the minor axis of the manhole in inches.

5. **Seamless Receivers.**—In the case of seamless receivers, the rules for material will be the same as for boiler shells, but the permissible extension may be 2 per cent. less than that required with boiler plates.

The thicknesses of seamless receivers are to be verified by the Surveyor before the ends are closed in, and at this time the Surveyor is to select and mark the test pieces required from either of the open ends of the tube. The test pieces are to be subjected to the same heat treatment as that given to the receivers.

6. The permissible working pressure for seamless receivers is to be determined by the following formulæ:—

$$WP = \frac{C \times S \times (t - 4)}{D}$$

for thicknesses of $\frac{5}{8}$ inch and above.

$$WP = \frac{C \times S \times (t - 2)}{D}$$

for thicknesses below $\frac{5}{8}$ inch.

where WP is the working pressure in lb. per square inch,

S is the minimum tensile strength of the steel shell plates in tons per square inch,

t is the thickness of the shell plates in 32nds of an inch,

D is the internal diameter in inches,

C = 38·5 for receivers of thickness $\frac{5}{8}$ inch and above

C = 34·5 for receivers of thickness below $\frac{5}{8}$ inch.

7. Each seamless receiver is to be carefully annealed after manufacture, and before the hydraulic test.

8. Each seamless receiver is to be subjected to a hydraulic test of twice the working pressure, which it shall withstand without permanent set.

9. Each receiver made of riveted steel plates for pressures up to 300 lb. per sq. inch is to be tested by hydraulic pressure to $1\frac{1}{2}$ times the working pressure, plus 50 lb. per sq. inch. Where higher working pressures are used, the test pressure need not be more than 200 lb. per sq. inch above the working pressure.

10. All receivers above six inches internal diameter are to be so made that the internal surfaces may be examined, and, wherever practicable, the openings for this purpose are to be sufficiently large for access. Means are to be provided for cleaning the inner surfaces by steam, or otherwise.

11. Each receiver which can be isolated from a safety valve is to be provided with a suitable fusible plug to discharge the contents in case of fire.

12. Each receiver is to be fitted with a drain arrangement at its lowest part, permitting oil and condensed water to be blown out.

13. Oil or air pipes subjected to high pressure are to comply with the requirements for steam pipes, **Section 13, clauses 7 and 16 (Rules for Engines and Boilers of Steam Vessels).**

Where solid drawn steel pipes are used and the material complies with the requirements of **Section 16** of the **Rules for Quality and Testing of Materials,** the working pressure may be determined from the following formula:—

$$WP = \frac{(t - 4)}{D} \times 114$$

where WP is the working pressure in lb. per square inch to which the pipes will be subjected,

D is the internal diameter of the pipes, in inches,

t is the thickness of the pipes, in 100ths of an inch.

Pipes which are subjected to a working pressure up to 1,000 lb. per square inch are to be tested hydraulically to at least twice the working pressure to which they will be subjected, and those subjected to a higher working pressure than 1,000 lb. per square inch to an hydraulic test of at least 1,000 lb. per square inch above their working pressure.

PUMPING ARRANGEMENTS.

Section 7. 1. The pumping arrangements are to be the same as would be required for steam vessels of similar size and power.

Where a bilge suction from the main water circulating pump is not fitted, a power pump direct bilge suction is to be fitted additional to the direct bilge suction required by **Section 4, clause 5** (*d*) of the **Rules for Engines and Boilers.**

These direct suctions are to be led from separate pumps.

2. One bilge pump worked from the main engines will be sufficient, where the brake horse power does not exceed 350, provided that the independent power pump required by **Section 4, clause 4** of the **Rules for Engines and Boilers** be fitted.

3. Where the cooling water discharge from various parts of the engines is led to the bilges, special arrangements are to be made to deal with this water, in addition to the ordinary bilge pumping arrangements.

MISCELLANEOUS.

Section 8. 1. All oil fuel pipes, tanks and their fittings are to comply with the requirements of **Section 20 (Rules for Steel Ships).**

2. Special attention is to be given to the ventilation of the engine room.

3. If the auxiliaries are worked by electricity, the cables, motors, control gear and electrical spares in connection with them are to be in accordance with the **Rules for Electrical Equipment.**

4. All pipes conveying fuel oil are, as far as possible, to be made of steel or iron.

SPARE GEAR.

Section 9. In vessels engaged on ocean going service, the articles mentioned in the following list (so far as they are applicable) will be required to be carried, viz.:—

*For a single screw ship a propeller, or two blades with studs and nuts for one blade. The propeller or blades may be of cast iron, except for ships having the notation "Strengthened for Navigation in Ice."

For Main Engines.

*1 cylinder cover of each design used, complete with all valves, valve casings, springs and other fittings and, in addition, one complete set of valves for one cylinder, with their casings, springs and other fittings.

For Main Engines—*Continued.*

Fuel needle valves for half the number of cylinders of each engine.

*1 piston complete, with all piston rings, studs and nuts.

1 set of piston rings for one piston.

*1 complete cylinder liner.

Telescopic cooling pipes for one piston.

*1 set of wheels for the cam shaft drive of one engine or six separate links with pins and rollers where chain drive is used for cam shaft or scavenge blower.

1 set of studs and nuts for one cylinder cover of each design used.

1 set of rubber rings for liner joints.

2 cross head bearing bolts and nuts, or one gudgeon pin where trunk pistons are used.

1 complete crank pin bearing.

1 set of top end bearings.

1 set of packings for one piston rod for Double Acting Engines.

*1 piston rod for Double Acting Engines.

2 crank pin bearing bolts and nuts of each size used.

2 main bearing bolts and nuts.

1 set of pads of each hand for one face of Michell Thrust Block.

1 set of coupling bolts of each size used.

For Main Engine Air Compressors and Pumps.

1 set of piston rings for one piston of each size used in the air compressor.

1 half set of suction and delivery valves for each size used in the air compressor.

Not less than 10 per cent. of suction and delivery valves for the scavenge air pump where lift valves are used.

1 impeller, impeller shaft and bearings where scavenge blowers are used. Where more than one scavenge blower is fitted, and one of these is additional to the required capacity of blower or blowers, under full working conditions, no spare parts need be supplied provided the additional blower is arranged to be easily substituted for the working blowers.

1 set of bilge pump valves and seats.

1 additional fuel pump or all working parts for one fuel pump.

* Not required for vessels engaged on short voyages.

For each size of Auxiliary Heavy Oil Engine.

1 complete set of valves for one cylinder, with their springs and other fittings.

Fuel needle valves for half the number of cylinders.

1 set of piston rings for one piston.

1 set of studs and nuts for one cylinder cover.

2 crosshead bearing bolts and nuts, or one gudgeon pin where trunk pistons are used.

2 crank pin bearing bolts and nuts of each size used.

1 complete crank pin bearing.

1 complete top end bearing.

2 main bearing bolts and nuts.

1 set of piston rings for one piston of each size used in the air compressor.

1 half set of suction and delivery valves for each size used in the air compressor.

1 additional fuel pump or all working parts for one fuel pump.

For Auxiliary Air Compressors.

1 set of piston rings for one piston of each size used.

1 half set of suction and delivery valves of each size used.

71, Fenchurch Street, London, E.C.3.
17th October, 1946.

For Auxiliary Pumps.

1 set of valves of each size used for the liquid end of each pump.

For Donkey Boilers used for essential services at sea.

1 set of valves for the water end of the feed pump.

1 valve lid for feed check.

6 tube stoppers.

1 set of oil fuel burner nozzles complete with atomisers etc., for one boiler.

General.

A quantity of assorted studs, bolts and nuts.

Steel bars and plates of various sizes.

A length of pipe of each size used, for the fuel delivery and injection air pipes to the main and auxiliary power cylinders, and the air delivery from the main and auxiliary compressors to the receivers, with unions and flanges suitable for each.

PERIODICAL SURVEYS.

Section 10. The periodical surveys of the machinery are detailed on page 25 under "**Petrol, Paraffin, and Heavy Oil Engines.**"

ELECTRIC PROPELLING

MACHINERY.

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RULES FOR ELECTRIC PROPELLING MACHINERY.

(For Tables, see pages 250–261).

GENERAL.

Section 1. In vessels propelled by electrical machinery, either wholly or partly by this means, the Rules with regard to machinery are the same as those relating to steam engines so far as regards the testing of material used in their construction and fitting of sea connections, suction and discharge pipes, shafting, stern tubes and propellers.

The following rules are also to be observed. These relate to the electric propulsion equipment, with such references to the mechanical equipment as are required for the successful operation of the combined system. Such requirements are additional to those detailed in the appropriate sections of the Rules.

CONSTRUCTION.

Section 2. 1. In vessels built under special survey and fitted with electric propelling machinery, the whole of the electrical machinery, including switch gear, control gear, cables, main and auxiliary generators, motors and exciters, are to be constructed under special survey.

Any alterations and additions to the installation which are made are to be carried out under the inspection, and to the satisfaction, of the Surveyors.

2. In the cases of electric propelling machinery to engines being built under special survey, the distinguishing mark ✠ will be noted in the Register Book in red, thus:—✠LMC or ✠NE.

3. In order to facilitate the inspection, the plans of the machinery, control gear, cables and electric circuits are to be submitted for approval.

4. The Surveyors are to examine the materials and workmanship from the commencement of the work until the final test of the machinery under full power working conditions has been satisfactorily carried out. Any defects are to be pointed out as early as possible.

5. Any novelty in the construction, operation or application of the machinery is to be reported to the Committee and submitted for approval.

STEAM ENGINES FOR PROPULSION GENERATORS.

Section 3. 1. **Governing.**—An efficient governor is to be incorporated, which is to be arranged so that when operating at rated speed and the rated load is thrown off, the maximum variation in speed is not to be sufficient to bring the emergency governor into operation, and the permanent variation is not to exceed four per cent of the rated speed.

NOTE:—Exhaust steam turbines working in conjunction with reciprocating engines require an emergency overspeed governor only.

2. **Speed Control.**—When the propeller speed is arranged to be varied by controlling the engine speed the control is to be arranged to permit increments and decrements of speed not exceeding one per cent of maximum speed between 50 per cent and 100 per cent of maximum rated speed.

3. **Maximum Speed.**—The engines are to be capable of withstanding for five minutes without injury a speed of 15 per cent in excess of the maximum rated speed.

4. **Emergency Governor.**—An emergency overspeed governor, independent of the main governor, is to be arranged to trip the throttle valve when the speed exceeds the rated maximum running speed by not less than 10 nor more than 15 per cent. It is also to be arranged for hand tripping.

5. **Mixed Pressure Turbines.**—If, in the case of a turbine, exhaust steam can be admitted to the lower stages, an automatic shut-off controlled by the governor and emergency trip is also to be provided.

6. **Bled Steam.**—When provision is made for bleeding steam from the intermediate stages of a turbine, non-return valves, or positive shut off valves operated by the emergency governor, are to be fitted.

7. **Torque Limiting.**—In cases where the arrangements permit a propelling motor to be connected to generating plant having a continuous capacity higher than the motor rating, means are to be provided to limit the continuous input to the motor to approximately five per cent above the torque for which the shaft is approved.

8. **Lubricating Oil.**—Steam turbine driven sets are to be provided with a suitable emergency supply of lubricating oil as required by **Section 9** of the **Rules for Steam Engines,** to maintain lubrication until the unloaded turbine comes to rest from its maximum rated running speed.

9. **Mechanical Balance.**—The engines and generators are to be so constructed, erected and supported that when running at any and every working speed all revolving and reciprocating parts are well balanced so as not to give rise to any appreciable vibration.

OIL ENGINES FOR PROPULSION GENERATORS.

Section 4. 1. **Governing.**—An efficient governor capable of rapidly shutting off the flow of oil fuel is to be provided. It is to keep the engine speed within seven per cent momentarily and three and a half per cent permanently at full speed when full load is removed.

2. **Critical Speed.**—When coupled to the generator or generators, the combined set must not run in the vicinity of a serious critical at any designed running speed, or range of speeds.

Calculations of the torsional vibration characteristics for the dynamic system formed by the engine and generator or generators are to be submitted for consideration, together with plans of all shafting.

These calculations should include the particulars required by **Sections 3** and **4, clause 1** (a) **Rules for Heavy Oil Engines.**

In certain cases the Committee may consider it necessary for torsiograph readings to be taken from the machinery after fitting on board, for the purpose of verifying that serious critical speeds do not occur within the range of working speeds.

3. **Rating.**—The engine is to be capable, for periods of one hour, of developing a load 10 per cent above its rated output within the limits of variation in speed defined in **clause 1** without undue heating of the engine or other mechanical trouble. The rated output in B.H.P. (unless otherwise approved) is to be the load required to drive the generators and all direct coupled auxiliaries at their continuous maximum rating for a period of 12 hours when working with a barometric pressure of 30 inches of mercury and a surrounding air temperature of 62° F. (16·7° C.).

GENERAL REQUIREMENTS OF ELECTRIC PROPULSION MACHINES.

Section 5. 1. **Insulation.**—(*a*) All windings are to be insulated and treated to resist moisture, sea air and oil vapour.

(*b*) All windings are to be insulated from the frame with mica or micanite. Where it is desired to use other types of insulation, particulars regarding the behaviour, properties and life of the materials are to be submitted for consideration.

2. **Terminals.**—The terminals are to be so secured and spaced or shielded that they cannot be accidentally earthed, short circuited or touched. Cable conductors are to be furnished with appropriate sweating sockets.

3. **Coolers.**—If water coolers are employed they are to be arranged so as to prevent leakage or condensation from cooler tubes from entering the machines.

4. **Thermometers.**—Machines having an enclosed ventilating system or ducts for the exhaust air are to be fitted with thermometers for recording the temperature of the ventilating air as it leaves the machine.

5. **Ventilation.**—Ample provision is to be made for supplying cool air to and removing hot air from the machine and to avoid as far as practicable any intake of moist or oil-laden atmosphere.

Where the machines are not ventilated by a closed system, using water coolers, they are to be ventilated with cooling air not exceeding 113° F. (45° C.). In cases where the ventilating air exceeds 113° F. the permissible temperature rise of the machine is to be reduced by an amount equal to the excess temperature.

6. **Heating when Idle.**—All generators of 500 kw. or motors of 500 S.H.P. and over, are to be provided with efficient means for heating the windings, either electrically or otherwise, to prevent condensation when idle. If steam pipes are used for this purpose, the joints are not to be within the machine.

7. **Shaft Currents.**—Means are to be taken to prevent the formation of circulating currents which might flow between the shafts and the bearings.

8. **Excitation.**—(*a*) Systems dependent on the auxiliary generators for excitation are to be capable of manœuvring and of maintaining power at all times with a fall of 10 per cent of excitation voltage at the bus-bars.

(*b*) For large equipments an alternative means of excitation is to be provided. The auxiliary generators may constitute this reserve.

9. **Facilities for Inspection and Repair.**—For the purposes of inspection and repair, provision is to be made for the withdrawal and replacement of the field coils of direct current machines and salient pole alternating current machines, and for sufficient access to stator and armature coils. Facilities are to be provided for supporting the motor shaft to permit the withdrawal and inspection of bearing bushes. Wear-down gauges are to be supplied for generators of 1,000 kw., and motors of 1,000 S.H.P., and over.

10. **Mechanical Protection.**—Suitable handrails or screens are to be provided to prevent personal injury or the entrance of extraneous bodies. All live parts in excess of 250 volts to earth, are to be suitably guarded or enclosed. Machines are to be amply protected against drip and mechanical damage.

11. **Lubrication.**—(*a*) Means of lubrication are to be efficient at all running speeds and all normal working oil temperatures, and with the ship inclined from the normal at any angle up to 15° transversely and 10° longitudinally, and with rolling up to 22½° from the vertical without the spilling of oil.

(*b*) Oil flingers or other suitable means are to be provided to prevent the lubricant from creeping along the shaft or otherwise gaining access to the insulation of the machine or any live part thereof.

(*c*) Every self-lubricated sleeve bearing is to be provided with a suitable overflow which, while permitting efficient lubrication when the machine is running, is to prevent the bearing from containing an excess of oil. Every self-lubricated bearing is to be fitted with an inspection lid and means for visual indication of the oil level. Where forced lubrication is employed, an alternative means of lubrication, such as oil rings or an oil reservoir, is to be provided if no warning device is fitted, or a period of 30 seconds elapses before the machine comes to rest after the interruption of the oil supply.

The lubrication of propulsion motor bearings is to be effective at trailing speeds under all conditions of oil temperature.

12. **Position in Ship.**—(*a*) The machines are to be placed in well-ventilated compartments in which inflammable gases cannot accumulate, and in such a position as to be clear of all inflammable material. Unprotected woodwork or other combustible material is not to be fitted within a distance of 12 inches measured horizontally from, or within 4 feet measured vertically above the machines.

(*b*) The machines are to be placed in positions in which they are not exposed to risk of mechanical injury or to damage from water, steam or oil, and in all vessels engaged on open sea service they are preferably to be placed with their axes of rotation in a fore and aft direction. If placed athwartships end play is to be reduced to a minimum and provision made for the end thrust due to rolling of the vessel.

(*c*) Ventilation ducts are to be so arranged that water or extraneous bodies cannot drop into the machines.

13. **Foundations and Bilges.**—(*a*) Plans of the seatings for the main propulsion generators and motors, are to be submitted for approval.

(*b*) Special means are to be provided to prevent the accumulation of bilge water under the machines and a direct bilge suction should be fitted in the main motor room. It is recommended that permanent means of illumination of the bilges under the machines be provided.

14. **Manœuvring.**—The torque available for manœuvring is to be reasonably in excess of the trailing action of the propeller to enable the latter to be stopped or reversed in a reasonable time when the vessel is travelling at maximum service speed.

15. **Plant to be Earthed.**—The bed-plates and frames of the machines are to be effectively earthed, and insulation is not to be interposed between the prime movers and the generators.

ALTERNATING CURRENT SYSTEMS.

Section 6. 1. **Limiting Pressures.**—The pressure, under normal working conditions, at any part of the system for equipments not exceeding 15,000 S.H.P. per shaft is not to exceed the following values.

Between lines	...	3,500 volts.
To earth ...	...	2,020 volts.

Proposals involving higher voltages for larger equipments are to be submitted for consideration.

2. **Stator Laminations.**—(*a*) Laminations are to be securely clamped, and are to be efficiently and permanently supported around the whole of the periphery.

(*b*) Laminations are to be suitably insulated from one another with an approved durable material.

3. **Propulsion Generators.**—(*a*) The ratings and limits of permissible temperature rise for alternators are to conform to Appendix 4. If the ventilating air exceeds 113° F. (45° C.) the permissible temperature rise is to be reduced by an amount equal to the excess temperature.

Where sea water cooling is used the temperature rises specified in Appendix 4 may be increased by 18° F. (10° C.) provided that the maximum temperature of the air entering the machine does not exceed 104° F. (40° C.) when using sea water at 85° F. (29·5° C.).

(*b*) Machines of 5,000 k.v.a. and over, or machines having an axial core length of one metre or over, are to have at least three embedded temperature detectors and a temperature indicating instrument. Detectors of this type should be fitted to smaller machines where practicable.

(*c*) Suitable space is to be provided for the removal of the rotor for the inspection of the rotor and stator.

(*d*) Stator and rotor windings are to be suitable for manœuvring in accordance with clause 6 (*b*) of this Section without impairment.

4. **Propulsion Motors.**—(*a*) The ratings and limits of permissible temperature rise for motors are to conform to Appendix 4.

Where the temperature of the cooling air exceeds 113° F. (45° C.) the permissible temperature rise is to be reduced by an amount equal to the excess temperature.

Where sea water cooling is used the temperature rises specified in Appendix 4 may be increased by 18° F. (10° C.) provided that the maximum temperature of the air entering the machine does not exceed 104° F. (40° C.) when using sea water at 85° F. (29·5° C.)

(*b*) The collector rings and rotor terminals of synchronous type motors are to be suitably insulated for the voltage induced during manœuvring. Insulating barriers are to be provided where necessary.

(*c*) Induction rotor windings of synchronous type motors, used for manœuvring purposes, are to be mechanically strong and of ample section to prevent over-heating during repeated manœuvres in accordance with clause 6 (*b*) of this Section.

(*d*) Provision is to be made for machining the collector rings or for their easy removal for that purpose.

(*e*) Machines of 5,000 S.H.P. and over, or machines having an axial core length of one metre or over, are to have at least three embedded temperature detectors and a temperature indicating instrument. Detectors of this type should be fitted to smaller machines where practicable.

5. **Stability.**—The motors and generators are to be designed and arranged to maintain electrical stability and to remain in step under all normal conditions of running.

6. **Excitation.**—(*a*) Exciters, balancers, boosters and motors for driving them are to conform to Appendix 3, except that for all ocean-going ships and ships operating in tropical waters the temperature rise, measured by thermometer at the rated load, is not to exceed the limit shown in the following schedule :—

	Temperature Rise.	
	Class A Insulation.	Class B Insulation.
Windings (other than single-layer field windings with exposed surfaces) and cores with which they are in contact	63° F. (35° C.)	81° F. (45° C.)
Single-layer field windings with exposed surfaces	81° F. (45° C.)	108° F. (60° C.)
Commutators ...	72° F. (40° C.)	72° F. (40° C.)

Where the ventilating air adjacent to the machine exceeds 113° F. (45° C.) the permissible temperature rise of the machines is to be reduced by an amount equal to the excess temperature.

(*b*) After a full load run of the complete equipment, for not less than three hours, followed by a full speed reversal and five normal manœuvres within a period of 30 minutes, the temperature rise of any machine supplying the extra excitation required for alternating current systems, is not to exceed that permitted in the preceding clause by 18° F. (10° C.).

Ample margin in the temperature rise of machines is to be allowed for inadvertent delay in the operations of manœuvring referred to above.

(*c*) Field windings and all machines supplying over-excitation during manœuvring are to be capable of withstanding the excess current over a reasonable period, to allow for inadvertent delay during a reversal operation, without impairment, after attaining the temperature rise corresponding to normal continuous working.

(*d*) Negative boosters are, when necessary, to be provided with overspeed protection.

(*e*) The strength of shafts and couplings of exciting machines for alternating current equipments is to be suitable for the increased output necessary during manœuvring.

DIRECT CURRENT SYSTEMS.

Section 7. 1. **Limiting Pressures.**—For equipments not exceeding 15,000 S.H.P. per shaft the pressure to earth at any part of the system under normal working conditions is not to exceed 600 volts. The voltage of any single armature is not to exceed 1,000.

Proposals involving higher voltages for larger equipments are to be submitted for consideration.

2. **Propulsion Generators and Motors.**—The ratings and limits of permissible temperature rise are to conform to Appendix 4.

Where the temperature of the cooling air exceeds 113° F. (45° C.) the permissible temperature rise is to be reduced by an amount equal to the excess temperature.

3. **Brush Gear.**—The brushes are to be staggered longitudinally to prevent the formation of ridges on the commutators and arranged in such manner that in multipolar machines every part of the commutator working surface is swept by an equal number of positive and negative brushes.

Brush gear is to be mounted on the frame or bed-plate of pedestal-bearing machines having an output of 150 kw. per 1,000 revolutions per minute and above.

4. **Excitation.**—The arrangements for motor and generator excitation are to be such that if the motor excitation circuit is opened by a switch or contactor the generator excitation is simultaneously opened or the generator voltage is immediately reduced to zero.

5. **Overspeed Protection.** — Overspeed protection devices are to be arranged to interrupt the supply of power, and the armatures are to be suitably constructed to prevent damage due to temporary overspeeding, where the system permits excessive overspeeding at light loads.

GENERAL REQUIREMENTS FOR PROPULSION CONTROL GEAR AND SWITCHBOARDS.

Section 8. 1. **Position.**—(*a*) Control boards and switchboards are to be placed in accessible, well-ventilated positions, free from inflammable gases and acid fumes, and in which they are not exposed to risk of mechanical injury or damage from water, steam or oil.

(*b*) Unprotected woodwork or other combustible material is not to be fitted within a distance of 12 inches measured horizontally from, or four feet measured vertically above, any live metal.

(*c*) Essential controls for manœuvring operations are to be grouped at the starting platform and any necessary instruments and gauges are to be in direct view from this position.

2. **General Construction.**—(*a*) Switchboards and control panels are to be constructed wholly of durable, non-ignitable, non-absorbent materials.

(*b*) If insulating material be used for the base, it is to be of permanently high dielectric strength and insulation resistance, and full particulars regarding its properties should be submitted for consideration.

Where used for panels such materials are to be coated with insulating varnish or enamel over their entire surface including such parts as have been exposed by drilling or other machining operations.

(*c*) If semi-insulating materials such as marble or slate are used, all conducting parts are to be insulated from the slate or marble slab with mica or other approved non-hygroscopic insulating material, and the slab is to be similarly insulated as a whole from the frame on which it is mounted; the frame is to be effectually earthed.

(*d*) The various live parts are to be so arranged, by suitable spacing or shielding with non-ignitable insulating materials, that an arc cannot be maintained between any such parts, or between such parts and earth.

(*e*) All parts, including connections, are to be readily accessible from the front or back. Fuses are to be placed in approved positions.

(*f*) Omnibus bars and ordinary bare connecting conductors on switchboards are to be proportioned so that their average temperature will not rise more than 54° F. (30° C.) above that of the surrounding air when rated at 2,000 amperes or below when the maximum current flows through them continuously. For bare conductors rated above 2,000 amperes the temperature rise is not to exceed 72° F. (40° C.). The temperature rise of each part is not to exceed the average temperature by more than 9° F. (5° C.) and in other respects they are to comply with Appendix 1. Aluminium is not to be used.

(*g*) All cable connections in the control and switchgear in any circuit essential for manœuvring or maintenance of propelling power are to be stranded and to consist of not less than seven strands and have a sectional area of not less than ·0045 square inches (7/·029).

(*h*) All nuts and screws securing electrical connections are to be effectively locked so that they cannot become loose.

(*i*) All circuits, instruments and important apparatus are to be clearly and indelibly labelled for indentification. If detachable name plates are employed, they are to be non-ignitable, and if of metal are to be disposed so as not to involve risk of short circuits or earths.

(*j*) Each voltmeter, wattmeter, voltage coil and pilot or earth lamp with its connecting wires is to be protected individually by a fuse on each insulated pole close to the source of supply. Potential transformers for instruments, relays, etc., may be protected by fuses on the primary side only.

Pilot lamps and indicating lamps may have common fuses.

(*k*) Switches and contactors are as far as practicable to be connected so that their blades or moving parts are not alive in the "off" or de-energised position.

(*l*) Where switches and fuses are fitted on the same pole they are to be arranged so that the fuses are not alive when the corresponding switches are in the "off" position.

(*m*) Switches and circuit breakers are to conform to the **Rules for Electrical Equipment, Section 3, clause 19.**

(*n*) Fusible cut-outs are to comply with the **Rules for Electrical Equipment, Section 3, clause 20,** and are to be suitably labelled with the circuits or devices which they control.

(*o*) All levers, handles, handwheels, interlocks, and their connecting links, shafts and bearings for the operation of switches and contactors are to be of such proportions that they cannot be broken by manual operation.

(*p*) Suitable interlocks, preferably mechanical, are to be provided to prevent damage by improper operation, such as the opening of switches or contactors not intended to be operated while carrying current.

(*q*) Provision is to be made for the manual operation of all manœuvring contactors, switches, field regulators, or controllers with reasonable effort, without the aid of solenoids or other electric, pneumatic or hydraulic aid. If such aid be used for normal operation, failure of the electric, pneumatic or hydraulic aid must not result in interruption of power to the screw shaft and the device must be capable of purely manual operation without any delay in changing over to manual control.

NOTE:—This requirement does not apply to bridge control.

(*r*) Where voltage coils are used for relays or for retaining purposes, the coils and resistances in series with them, if any, are to be of substantial and reliable construction where failure of such coils would result in the interruption of the supply of power to the propeller shaft. The number of such coils in a propelling system and the number of auxiliary contacts in series with them is to be reduced to a minimum.

(*s*) The cases of all instruments using a higher pressure than 250 volts direct current to earth or 120 volts alternating current to earth, and secondary windings of all instrument transformers, are to be earthed.

(*t*) Switches normally subject to arcing, such as the short circuiting and isolating switches for direct current generators connected in series, are to be provided with substantial and renewable arcing tips.

(*u*) All apparatus is to be arranged to function satisfactorily under conditions of vibration and shock, and with the ship inclined from the normal at any angle up to 15° transversely and 10° longitudinally, and when rolling up to 22½° from the vertical.

(*v*) Shunt-operated contactors, releases, and relays are to be capable of functioning satisfactorily even when the line voltage falls to 80 per cent and 85 per cent for direct current circuits and alternating current circuits respectively, with the coils at the temperature which they will attain under normal service at the normal line voltage, and, in the case of alternating current circuits, at rated frequency.

(*w*) For the purpose of maintaining alignment and ease of operation, operating shafts are to be fitted with flexible couplings and expansion joints where necessary and means are to be provided for effective lubrication.

(*x*) All steel parts, including springs, are to be suitably treated to resist corrosion.

3. **Overload and Short Circuit Protection.**—Provision is to be made for protection against severe overloads or electrical faults likely to result in serious injury to the plant, but the operating point is to be set sufficiently above the currents and loads usually experienced in a heavy sea-way or when manœuvring, to prevent interruption of power.

4. **Earth Detection.**—(*a*) The main propelling circuit is to be provided with means for detecting earth faults.

(*b*) For D.C. equipments exceeding 500 volts and for all A.C. equipments, aural and visual alarms are to be operated, but power supply is not to be interrupted on the occurrence of a fault, so that the plant may continue to operate with a single earth. If an earth connection be used for the operation of the detector, the arrangements are to be such that the earth circuit is automatically opened in order to stop the circulation of fault current.

(*c*) Earth detection devices are to be arranged to function for all earth leakage faults exceeding five amperes. On three-phase alternating current systems at least 95 per cent of the generator and motor windings are to be protected.

(*d*) A switch may be installed to cut out the aural device to prevent continuous alarm, but in such case the visual device is to be automatically switched on when the aural device is switched off.

(*e*) Excitation circuits are to be provided with lamps, voltmeters or other suitable means to indicate continuously the state of the insulation of the system under running conditions.

5. **Mechanical Protection.**—All exposed current-carrying parts having a potential of over 250 volts direct current to earth or 120 volts alternating current to earth are to conform to the following requirements:—

(*a*) Terminals are to be enclosed.

(*b*) The sides and rear of switchboards and control panels are to be suitably screened.

(*c*) Access doors are to have prominent and permanent nameplates giving the maximum voltage, and are to be interlocked to prevent access while such parts are alive, or in approved cases are to be provided with a special key under the care of the chief engineer.

(*d*) Exposed current carrying parts exceeding 250 volts to earth are not to be permitted on any switchboard or control panel.

6. **Bridge or Deck Control.**—(*a*) The control is to be simple and easy to operate.

(*b*) It is to be such that the operator cannot produce currents or loads in excess of the working capacity for which the plant is designed.

(*c*) Control is to be carried out without reference to electrical instruments.

(*d*) Alternative control in the engine room is to be provided, and so arranged that transfer of control to the engine room can be made in emergency without excessive loss of time.

(*e*) It is to be arranged so that simultaneous control of the propelling machinery from the bridge and engine room is not possible.

7. **Instruments and Gauges.**—(*a*) Instruments and gauges which are necessary for the efficient operation of the plant are to be provided. Particulars are to be submitted for consideration. In cases where the rotation of the propeller motors cannot readily be observed from the starting platform, indicators are to be provided.

(*b*) All essential instruments are to be capable of withstanding vibration and shock without impairment and are to be fitted in moisture-proof cases.

(*c*) Instruments are where necessary to be protected from the influence of stray magnetic fields.

(*d*) A 500-volt insulation tester, giving the resistance in megohms, for the purpose of testing and tracing faults is to be carried on all sea-going vessels.

8. **Discharge Protection.**—(*a*) For the protection of the field windings and cables efficient means are to be provided for limiting the induced voltage when the field circuits are opened.

(*b*) Where excitation is obtained from the auxiliary bus-bars efficient means are to be provided to limit the induced voltage on the bus-bars when the generator or distribution circuit breaker opens.

9. **Direct-current Systems.**—(*a*) Where two or more direct-current generators are connected in series, means are to be provided to prevent the reversal of the prime mover on the failure of the power supply to any one generator if such reversal would result in damage or overspeeding.

(*b*) If the regenerated energy transmitted by the propeller motor on stopping or reversing the propeller is of a magnitude that would cause an undue increase in the engine speed, means are to be provided for suitably absorbing or limiting such power.

(*c*) Where the propulsion generators are also to be used for other purposes, suitable overload protection and provision for voltage adjustment is to be made in conformity with the **Rules for Electrical Equipment.**

10. **Reversing Switches.**—(*a*) Contactors or switches used for reversing the rotation of the propeller, are to be mechanically interlocked to prevent the circuits for ahead and astern rotation being closed simultaneously.

(*b*) The reversing contactors or switches are also to be provided with means for forcing them open if they should become stuck in the closed position.

11. **Resistances.**—(*a*) Resistances are to comply with **Section 13, clauses 2** (*d*) and **3,** of the **Rules for Electrical Equipment.**

(*b*) Shunt resistances connected across the field circuit of synchronous propelling motors when they are functioning as induction motors are to be suitably insulated for the voltage induced when reversing and amply rated to allow for inadvertent delay during the reversing operation.

12. **Temperature Alarm.**—Machines having an enclosed ventilating system or ducts for the exhaust air, are to have an aural alarm device arranged to operate when the outgoing air exceeds the predetermined safe value.

13. **Reversing Levers and Handwheels.**—Propeller reversing levers or handwheels are to be clearly and permanently marked with the positions for "ahead" and "astern" working. Levers or handwheels placed athwartships are to be arranged for right hand or clockwise rotation for ahead working or if operated in a fore and aft direction to be arranged to correspond with the direction in which the vessel is moving.

14. **Auxiliary Power.**—Distribution circuits connected to the auxiliary bus-bars for excitation and lubricating oil pumps, etc., are to be suitably protected from interruption due to overloading of non-essential circuits.

15. **Speed Control.** In multiple-propeller ships where the propeller speed is arranged to be varied by voltage control or other electrical method, means are to be provided to permit an adjustment between 50 per cent and 100 per cent of maximum rated speeds in a suitable number of steps.

CONDUCTORS AND CABLES.

Section 9. 1. **Conductors.**—(*a*) All conductors are to be of annealed copper conforming to the Standards of the International Electrotechnical Commission Publication No. 28.

(*b*) Where the insulating covering of the conductor contains sulphur, each wire is to be efficiently and uniformly coated with tin free from all impurities.

(*c*) Conductors in any circuit essential for manœuvring or maintenance of propelling power are to be stranded and to consist of not less than seven strands and to have a sectional area not less than ·0045 square inches (7/·029).

(*d*) The size of conductor is to be selected so that the drop in voltage, when carrying rated full load and overloads, is not greater than that allowed for in the design of the machines.

(*e*) The current in any conductor is not to exceed that given in **Tables I.** and **II.** when carrying current continuously or **Table III.** when intermittently loaded. In no case is a shorter rating than one half-hour to be taken. In the case of field discharge circuits, particulars should be submitted for consideration.

Field currents, when the windings are cold, are to be taken into consideration when determining the size of conductors.

(*f*) Where multicore cables are used the dimensions are to be submitted for approval.

(*g*) Bus-bars and connections are to be in accordance with Appendix 1 and, if used for connections to machines, must be rigidly and strongly supported, efficiently insulated and guarded, and protected from drip and jets of liquid or steam. Pipes are not to enter ducts containing such connections. Suitable means are to be arranged for draining any accumulation of moisture in ducts.

2. **Insulation and Protective Covering of Cables.**—(*a*) All cables are to conform to **Section 7** of the **Rules for Electrical Equipment.**

(*b*) For multicore cables the thickness of dielectric on each conductor is to be the same as for the same size of single core cable and the thickness of lead sheathing is to be in accordance with **Tables V., VI., VII.** and **VIII.** The bedding and diameter of wire armouring are to be in accordance with **Table IX.**

(*c*) All cables for pressures exceeding 250 volts direct current to earth or 120 volts alternating current to earth are to be lead covered. They are also to be armoured or protected in an approved manner. The thickness of dielectric and lead covering is to conform to **Table VII.** (1,000 volt paper or varnished cambric insulated), **Table VI.** (660 volt rubber insulated) or **Table VIII.** (3,300 volt paper or varnished cambric insulated).

A dielectric test is to be applied to all cables in accordance with the **Rules for Electrical Equipment, Section 7, clause 12.**

3. **Installing and Fixing of Cables.**—(*a*) All cables are to be installed and fixed in conformity with **Section 9** of the **Rules for Electrical Equipment.**

(*b*) Cables are to be run in accessible, well-ventilated positions where they can be easily inspected.

4. **Cables for Alternating Currents.**—(*a*) Single core lead-covered cables are to have their lead sheaths bonded together and earthed only at approximately the mid-point of the cable run, or alternatively, earthed at both ends, provided that, in the latter instance, the cross-sectional areas of the cables are so increased as to compensate for the increased heating. The remainder of the run is to be carried on insulators to prevent the circulation of currents in the metal sheaths. The sheaths of multiconductor cables are to be earthed at each end and long runs should also be earthed intermediately.

(*b*) If armoured single core cables are used the armouring is to be of non-magnetic material.

(*c*) Magnetic material is not to be used between single core cables of a group. Where cables pass through bulkheads or steel panels, all the conductors of the same set are to pass through a non-ferrous plate or gland so that no magnetic material passes between the cables, and the clearance between the cables and magnetic material is to be not less than three inches.

NOTE :—This clause does not apply to cables carrying 10 amperes or less.

(*d*) Single core cables carrying 100 amperes or over are to be fixed not less than three inches from parallel magnetic material.

(*e*) Single core cables are to be so arranged that the inductive effects of the group are practically eliminated.

5. **Cable Sockets.**—Large cable sockets are preferably to be secured by two or more studs or bolts, not exceeding $\frac{3}{4}$ inch diameter, and the nuts securely locked.

6. **Synchronous Motor Cables.**—Cables connected to the collector rings of synchronous motors during manœuvring are to be suitable for the voltage induced during those periods.

7. **Interference with Magnetic Compasses.**—Single-conductor circuits carrying continuous current are to be arranged with lead and return conductors fitted as close to one another as possible. Tests are to be made during the adjustment of the compasses to determine the effect of switching the main circuits on and off and careful records are to be kept of any errors observed, whether corrected or not.

SECONDARY BATTERIES.

Section 10. 1. **General.**—All batteries are to conform to **Section 16** of the **Rules for Electrical Equipment.**

2. **Capacity.**—Batteries used for starting main propulsion engines in lieu of compressed air are to comply with the following :—

(*a*) If used for purposes other than starting, full particulars of the battery should be submitted for consideration.

These particulars should include the capacity which it is estimated will be required to give 12 starts in succession of one main engine, also details of the other uses for which the battery is intended; the facilities for charging should also be indicated.

(*b*) If used solely for starting main engines two batteries are to be fitted each capable of starting one main engine six times in succession without recharging. Details of the charging arrangements are to be submitted for consideration.

(*c*) Plans showing the location and arrangement of battery compartment are to be submitted for approval.

TRIALS.

Section 11. 1. **Works Tests.**—(*a*) The machines, switchgear, main cables and control gear, are to be tested in the presence of the Surveyors at the makers' works so far as practicable to ensure compliance with the requirements relating to temperature rise, dielectric strength, insulation resistance and operating characteristics.

(*b*) The dielectric test to be applied to the control gear is to be equal to the test for that part of the machine to which it is to be connected or otherwise is to be 1,000 volts plus twice the rated voltage of the circuit with a minimum of 2,000 volts between poles and between current-carrying parts and earth; the test voltage is to be maintained for one minute and is to be made with alternating current at any convenient frequency between 25 and 100 cycles per second.

(*c*) The rotor windings of turbine driven alternators are to be tested for insulation resistance when rotating at maximum rated speed, as well as at standstill.

2. **Ship Trials.**—After installation on board the entire propelling equipment is to be tested under working conditions and operated in the presence of the Surveyors and to their satisfaction.

The insulation resistance of the main windings of each machine in megohms should be not less than

$$\frac{3 \times \text{rated voltage}}{\text{rated k.v.a.} + 1{,}000}$$

The insulation resistance of cables, field windings and control gear when isolated and separated for testing purposes should be not less than one megohm.

All insulation tests are to be made where possible when the machines are hot and with a D.C. voltage of about 500 applied for sufficient time for the indicator to become practically steady.

71, Fenchurch Street, London, E.C.3.

17th October, 1946.

SPARE GEAR.

Section 12. Owing to the varied character of equipments an exact list of spares cannot be specified and a list should be submitted for consideration together with or subsequent to the submission of final plans. The following should be included as a minimum for all vessels engaged in open-sea service.

1. **For Generators, Motors and Exciters.**

One set of bearing bushes, with oil rings, if used, of each size and type for the propulsion generators, motor and exciter.

Two lines of brush holders of each size and type.

One set of carbon brushes for one generator, exciter, and one motor.

One shunt field coil of each size and kind used for D.C. generators, exciter and motors.

One set of insulation or insulated brush studs for two lines of brushes of each size and type.

In cases where there is no stand-by exciter or alternative means of excitation, spare armatures for the excitation machines may be required.

One set of slip rings for one motor if of the A.C. type.

2. **Switch and Control Gear.**

One set of contacts liable to burning or wear.

One set of springs.

Ten per cent of each different resistance element, but at least one of each.

One of each type of shunt wound coil used for contactors, relays, or trip coils.

Two fuse handles of each type and size, or 10 per cent, but not less than 12 of each type of cartridge or other non-rewireable cut-out.

3. **General.**

Special dismantling tools, if any, required for overhauling machines or control gear.

100 yards of control cable.

A suitable quantity of insulating tape and fuse wire.

4. **Storing.**

Electrical spares should be protected against excessive heat, and against moisture and rodents, and should be periodically tested.

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RULES FOR ELECTRICAL EQUIPMENT.

(For purposes other than Electric Propulsion.)

(For Tables, see pages 250-261).

GENERAL.

Section 1. 1.—In cases in which electricity is used on board classed vessels for purposes other than electric propulsion, the following Rules are to be observed.

(*a*) The equipment and installation are to be inspected and tested by the Surveyors.

(*b*) In order to facilitate inspection, an arrangement plan and circuit diagram of the switchboard, also diagrams of the wiring system showing cable sizes, type of dielectric, and normal working current in the circuits are to be submitted in triplicate for approval. The plans are to state the insulating material used for the switchboard panels, the materials used for insulating bushes, if any, and the capacity, type and make of fuses.

(*c*) All conductors, switchgear, and accessories, are to be of such size as to be capable of carrying, without their respective ratings being exceeded, the maximum current which can normally flow through them.

(*d*) Any novelty in construction, materials or design not specifically dealt with in these Rules is to be reported to the Committee.

(*e*) In special cases the Committee are prepared, at the request of the Owners, to accept installations which, whilst not precisely in accordance with the detailed requirements of the Society's Rules, comply either wholly or in part with a Code of Regulations officially recognised by the Law of the Country in which the vessel is owned, provided such Code or appropriate section thereof governing the equipment is considered to be equivalent to the Society's Rules.

In such cases the requirements with regard to inspection and testing and the submission of plans are to be carried out in accordance with the requirements of the Society's Rules.

(*f*) An addition, temporary or permanent, is not to be made to the authorized load of an existing installation until it has been definitely ascertained that the current-carrying capacity and the condition of the existing accessories, conductors, switchgear, etc., affected are adequate for the increased load.

(*g*) Alterations and additions to the installation are to be carried out under the inspection, and to the satisfaction, of the Surveyors. If the alterations are extensive, plans are to be submitted for approval.

2. **Standard Systems.**—The following systems of distribution may be used:—

A. Parallel systems with constant pressure.
   - (*a*) Single wire with hull return.
   - (*b*) Two-wire with direct or single-phase alternating current.
   - (*c*) Three-wire with direct current.
   - (*d*) Three-phase three-wire.
   - (*e*) Three-phase four-wire.

B. Series systems with constant current (direct current only).

3. **Limiting Pressures.**—The pressure of supply is not to exceed the following values:—

A. With direct-current constant-pressure systems:—
   - (*a*) For power, 500 volts.
   - (*b*) For lighting and heating, 250 volts.

B. With alternating-current systems:—
   - (*a*) For power, single-phase, 250 volts.
   - (*b*) For power, three-phase, 440 volts.
   - (*c*) For heating, 250 volts.
   - (*d*) For lighting, 150 volts.

C. With constant-current series systems (direct current only):—650 volts.

For ships carrying oil having a flash point less than 150° F. (65·5° C.)—*See* **Section 15.**

GENERATING PLANT.

Section 2. 1. **Prime Movers.**—(*a*) **Prime Movers are to be fitted with governors which, with fixed setting are to control the speed within the following limits:—**

10 per cent momentary variation and 6 per cent permanent variation in speed when full load is suddenly taken off or put on.

(*b*) Where a turbine-driven direct-current generator is arranged to run in parallel with other generators, a switch is to be fitted on each turbine emergency governor to open the generator circuit-breaker when the emergency governor functions.

(*c*) The normal running speed of a combined generating set is not to be in the vicinity of a torsional critical speed.

2. **Rating of Generators.**—Generators are to conform to Appendix No. 3, except that for all ocean-going ships and ships operating in tropical waters the temperature rise, measured by thermometer, at rated load and under working conditions is not to exceed the limits shown in the following Schedule :—

	TEMPERATURE RISE.	
	Class A Insulation.	Class B Insulation.
Windings (other than single-layer field windings with exposed surfaces) and cores with which they are in contact	63° F. (35° C.)	81° F. (45° C.)
Single-layer field windings with exposed surface ...	81° F. (45° C.)	108° F. (60° C.)
Commutators ...	72° F. (40° C.)	72° F. (40° C.)

3. **Flameproof Generators.**—Are to conform to Appendix No. 6. The temperature rises at rated load are not to exceed 81° F. (45° C.) on the windings and 90° F. (50° C.) on the commutator, all temperatures being measured by thermometer.

4. **Excessive Ambient Temperature.**—Where the temperature of the cooling air exceeds 113° F. (45° C.) the permissible temperature rise of the generators is to be reduced by an amount equal to the excess temperature.

5. **Direct Current Generator Characteristics.**—(*a*) Generators other than those referred to in clause (*e*) below are to be cumulatively compound wound, except that where parallel-connected generators are installed so far apart as to render excessive the amount of copper in the equalizing conductors, the generators may be shunt wound or compound wound. The series field windings are to be connected to the negative terminals of the generators

(*b*) When tested with their prime movers, or when tested separately and the speed regulation of the prime mover is known, unless otherwise specified, generators are to be flat compounded with the shunt field windings self-excited and without alteration to the initial (normal voltage) adjustment of the shunt-field regulators. Where a generator is tested separately and the speed regulation of the prime mover is not known, the permanent increase in speed when the rated load is thrown off is to be taken as 4 per cent. of the full load speed, but the generator is to be arranged so that, if required, it can be flat compounded with a permanent increase in speed of 6 per cent.

(*c*) Adjustment of compounding (if required) is to be effected before the acceptance test at the maker's works. For generators larger than 400 kw. per 1,000 revolutions per minute this adjustment is to be made by means of diverters, the generator brushes being in the neutral position. For smaller generators this adjustment may, if desired, be made by movement of the brush position, provided that such movement is not to effect an alteration in the voltage of more than 2 per cent of the rated voltage.

(*d*) Where a generator with shunt characteristics is arranged for parallel running with other generators, and is tested with its prime mover (the shunt field winding being self-excited) and with a fixed setting of the shunt field regulator (*see* clause 6), the no-load voltage is not to be exceeded at any load, and the no-load voltage is not to exceed the full-load voltage by more than 15 per cent. The requirements of this clause do not preclude the use of compounding for the purpose of obtaining the correct generator characteristics.

(*e*) Generators used for charging secondary batteries without the use of regulating resistors in series with the batteries are either to be shunt wound, or to be compound wound and provided with switches to cut out the series windings.

(*f*) Generators driven direct from the screwshaft or the main engines are to be provided with suitable means for automatically maintaining a constant voltage at the distribution busbars.

(*g*) Diverters are not to be connected across commutating pole windings.

6. **Field Regulation for Direct Current Generators.**—An adjustable regulating resistor is to be connected in series with each generator shunt field winding. This regulator is to be capable of adjusting the

voltage of the generator to within 0·5 per cent of the rated voltage for machines above 100 kw. and 1 per cent of the rated voltage for smaller machines at all loads between no load and full load, with the generator coupled to its prime mover, at any permissible temperature within the working range. At the conclusion of the full load temperature test, with full load current and normal full load voltage at the terminals when running at full load engine speed, the voltage across the shunt field regulator with an ambient of 60° F. (15·6° C.) is not to be less than 14 per cent of the terminal voltage of the machine. The regulator is to be capable of reducing the no-load voltage to 10 per cent below the rated voltage with the generator cold and the same ambient air temperature.

7. **Generator Rating Plate.**—Every generator is to be fitted with a rating plate clearly and indelibly marked with the following information :—

(*a*) Maker's name and machine number.

(*b*) Nature of supply—D.C. or A.C., voltage, frequency, number of phases, etc.

(*c*) Amps. power-factor, K.V.A.

(*d*) Speed.

(*e*) Winding type, i.e., compound, shunt, separately excited.

(*f*) Excitation voltage if separately excited.

8. **Testing.**—Every generator is to be tested at the maker's works, and a certificate giving the results is to be submitted for approval.

The tests are to include :—

(*a*) A temperature test at full load.

(*b*) Regulation (compounding).

(*c*) Voltage range with shunt regulator.

(*d*) Insulation resistance.

(*e*) High potential test.

Machines of 100 kw. and over are to be inspected by the Surveyors during manufacture and testing.

9. **Construction of Generators.**—(*a*) All working parts of generators are to be readily accessible, and all accessible live parts the voltage of which exceeds 250 volts direct current to earth or 120 volts alternating current to earth are to be suitably guarded or enclosed.

(*b*) Only Class A or Class B insulating materials in accordance with Appendix No. 2 are to be used in the construction of generators. All generator windings are to be insulated from their frames and/or cores with mica or micanite, and the insulation between bar-wound armature conductors between upper and lower layers or equivalent portions, between which there is periodic full rated voltage, are to be of micanite or other non-hygoscopic non-inflammable material. All generator windings are to be treated to resist moisture, sea air, and oil vapour.

(*c*) Brush position. The final running position of the brushgear is to be clearly and permanently marked.

10. **Commutator Brushes.**—(*a*) Generator brushes for use on commutators or sliprings are to be of carbon, graphite, or metal-graphite, and are to be provided with flexible copper connections.

(*b*) Commutator brushes are to be staggered longitudinally in such a manner that in multipolar generators every part of the commutator working surface is swept by the brushes, to prevent the formation of ridges. The staggering is to be so arranged that in multipolar generators a positive brush is always in line with a negative brush on an adjacent brush arm.

Generator brushgear is to be mounted on the frame or bedplate of pedestal-bearing machines of 150 kw. per 1,000 revolutions per minute and above.

11. **Terminals.**—Suitable terminals, clearly marked, are to be provided in an accessible position, convenient for wiring, and where cable connections are used they are to be provided with cable sweating sockets. The terminals are to be effectually secured and are to be so spaced and/or shielded that they cannot be accidentally earthed, short-circuited, or touched.

12. **Mechanical Balance.**—All generating plant is to be so constructed, erected, and supported, that when running at any and every working speed all revolving and reciprocating parts are well balanced, and the plant is not to give rise to any appreciable vibration on the test bed and in service.

13. **Lubrication.**—(*a*) Generators and their prime movers are to be efficiently and continuously lubricated automatically at all running speeds and all normal working oil temperatures and, except for the generators of emergency sets (*see* clause 19), with the ship inclined from the normal at any angle up to 15 degrees transversely and 10 degrees longitudinally, and when rolling up to 22½ degrees from the vertical without the spilling of oil. Where ring lubrication is employed, the rings are to be so constrained that they cannot leave the shaft Oil flingers or other

suitable means are to be provided to prevent the lubricant from creeping along the shaft, or otherwise gaining access to the insulation of the machine or any live part thereof. Every oil-lubricated bearing is to be provided with a suitable overflow which, while permitting efficient lubrication when the machine is running, is to prevent the bearing from containing an excess of oil.

(*b*) Every self-lubricated sleeve bearing is to be fitted with an inspection lid and means for visual indication of the oil level.

14. Plant to be Earthed.—The bedplates and frames of the generating plant are to be effectually earthed, and insulation is not to be interposed between the prime movers and the generators.

15. Shaft Currents.—Means are to be taken to prevent the induction of currents likely to circulate between the shafts and the bearings.

16. Spare Plant.—Every sea-going ship in which electric power is used for essential services is, except where other means are available for maintaining these services, to be provided with two or more generating sets of such combined output that in the event of one set being disabled the remaining generating plant is capable of supplying the essential services.

17. Position in Ship.—(*a*) The compartments in which the machines are placed are to be well ventilated, and free from the likelihood of an accumulation of inflammable gases. The machines are to be clear of all inflammable material and easily accessible, and they are to be so arranged that under any condition of excitation the compasses are not appreciably affected.

(*b*) Generators are to be placed in positions in which they are not exposed to risk of mechanical injury or to damage from water, steam, or oil. Every open-type generator is to be fitted with a canopy to protect the windings and commutator from drip. Suitable handrails are to be provided where necessary to obviate the risk of injury to persons.

(*c*) Generators other than those of emergency sets are preferably to be placed with their axes of rotation in a fore-and-aft direction.

(*d*) No unprotected woodwork or unprotected, readily combustible material is to be within a distance of 12 inches measured horizontally from, or within 4 feet measured vertically above, any generator, unless the latter is of the enclosed type.

18. Ventilation.—Ample provision is to be made for supplying clean cool air to, and removing hot air from, the generators, and for preventing the admission of moist or oil-laden atmosphere. Where the generators are not ventilated by a closed system using water coolers, they are to be ventilated with cool air.

19. Emergency Sets.—Emergency sets are, if practicable, to be placed with their axes of rotation in a fore-and-aft direction. The lubrication of emergency sets shall be efficient, without the spilling of oil, at all running speeds and all normal working oil temperatures, and with the ship inclined from the normal at any angle up to 22½ degrees transversely and 15 degrees longitudinally.

SWITCHBOARDS AND SWITCHGEAR

(other than Machine Control Gear, dealt with in Section 13).

Section 3. **1. Position of Switchboards.**—(*a*) Switchboards are to be placed in accessible well-ventilated positions, free from inflammable gases and acid fumes, and in which they are not exposed to risk of mechanical injury or to damage from water, steam, or oil.

(*b*) No unprotected woodwork or unprotected, readily combustible material is to be within a distance of 12 inches measured horizontally from, or within 4 feet measured vertically above, any live metal.

(*c*) Cupboards or compartments containing switchboards must be composed of fire-resisting material or approved lining.

2. Materials.—(*a*) Switchboards are to be constructed wholly of durable, self-extinguishing, non-absorbent materials, except as allowed by clause (*c*) below.

(*b*) Where synthetic insulating material is used, it is to be of permanently high dielectric strength and insulation resistance and non-hygroscopic, and full particulars of appropriate type tests are to be submitted for consideration (*see* Appendix 2, paragraph 2). Only approved materials are to be used. Where used for panels, such materials are to be coated with insulating varnish or enamel over their entire surface, including such parts as have been exposed by drilling or other machining operations.

(*c*) Where semi-insulating materials such as marble or slate are used, all conducting parts on each

insulated pole are to be insulated from the slate or marble slabs with bushes and washers of mica or other non-absorbent insulating material.

3. **General Construction.**—(*a*) The various live parts are to be so arranged, by suitable spacing or shielding with non-ignitable insulating material, that an arc cannot be maintained between any such parts or between such parts and earth.

(*b*) All parts, including connections, are to be readily accessible, and live parts mounted on the back of panels and distribution fuse-boards are to be so screened as to prevent them from being inadvertently touched.

(*c*) Every fuse (other than one protecting an instrument or a pilot lamp) fixed on a switchboard is to be fitted on the front thereof, subject to the exception that it may, if desired, be mounted on a framework behind the switchboard, provided that the fuse is well clear of busbars, connections, circuit-breakers, and live parts, and an unobstructed gangway of not less than 2 feet is left behind the switchboard.

(*d*) All nuts and screws which are used in connection with current-carrying parts and working parts are to be effectually locked so that they cannot become loose.

(*e*) The connecting wires to every voltmeter, wattmeter voltage coil, and pilot lamp (if any), and to every earth lamp, are to be protected individually by a fuse on each insulated pole, the fuse being placed as near as practicable to the source of supply.

(*f*) Switches and contactors are, whenever practicable, to be so connected that their blades or moving parts are not alive in the "off" or de-energized position.

(*g*) Every equalizer switch and its busbar is to have a current-carrying capacity of not less than half the full-load current of the generator.

(*h*) Switches and fuses fitted on the same pole are, wherever practicable, to be so arranged that the fuses are not alive when the corresponding switches are in the "off" position.

(*i*) Where single-pole switches or fuse-switches are required under these Rules, they are to be fitted on the same pole throughout the installation.

4. **Earthing of Frame.**—The frame, if of metal, is to be effectually earthed.

5. **Busbars, etc.**—All busbars and busbar connections on switchboards are to be of copper and are to comply with the requirements of Appendix 1.

6. **Fuse-Switches and Circuit-Breakers.**—Where a separate fuse and switch, or separate fuses and a linked switch, are required under these Rules, they may, if desired, be replaced by an overload circuit-breaker (or fuse-switch) or by a linked overload circuit-breaker (or a linked fuse-switch) respectively.

7. **Labels.**—All measuring instruments and all apparatus controlling circuits are to be clearly and indelibly labelled for identification. An indelible label is to be permanently secured to, or adjacent to, every fuse and every circuit-breaker, and marked with particulars of the full-load current of the generator or cable which the fuse or circuit-breaker protects. The labels for rewirable fuses are also to be marked with the appropriate size of fuse-element. Where inverse-time-limit and/or reverse current devices are provided in connection with a circuit-breaker, the appropriate settings of these devices are also to be stated on the label. Nameplates are to be of non-ignitable material, and, if of metal, they are to be so disposed as not to involve risk of short circuits or earth faults.

8. **Inclination, Vibration and Shock.**—All apparatus is to be arranged to function satisfactorily with the ship inclined from the normal at any angle up to 15 degrees transversely and 10 degrees longitudinally, and when rolling up to 22½ degrees from the vertical, and under such conditions of vibration and shock as are likely to arise in practice.

Apparatus connected to the emergency system is to be satisfactory with the ship inclined up to 22½ degrees transversely and 15 degrees longitudinally.

9. **Generator Switchgear.**—Every main switchboard and every emergency switchboard is to be fitted as a minimum with the following switchgear for each generator installed:—

(*a*) Where only one direct-current generator is installed, or where more than one generator is installed, the generators not being arranged to run in parallel:—

(i) If a single-wire or a two-wire earthed system: either a single-pole overload circuit-breaker, or a fuse and a single-pole switch, on the insulated pole.

(ii) If a two-wire insulation system: either a double-pole overload circuit-breaker, or a fuse on each pole and a double-pole linked switch.

(*b*) Where more than one direct-current generator is installed, the generators being arranged to run in parallel:—

For each generator: a circuit-breaker with overload and reverse-current trips. If the generator be flat compounded in accordance with Section 2, clause 5, a single-pole equalizer switch is to be so interlocked with each circuit-breaker that it must be closed before the circuit-breaker and cannot be opened until the main circuit is opened. The reverse-current protection is to be connected on the positive pole (i.e., the pole opposite to that on which the equalizer connection is made). In a single-wire system or a two-wire earthed system the circuit-breaker is to be of the single-pole type, and in a two-wire insulated system it is to be of the double-pole type.

(*c*) In direct-current three-wire systems where more than one generator is installed the generators being arranged to run in parallel:—

(i) For each generator if shunt-wound: a double pole circuit-breaker with overload and reverse-current protection and a single pole "neutral" isolating switch.

(ii) For each generator if compound-wound, the series field winding being connected to one pole: a circuit-breaker in each "outer" conductor with overload and reverse-current protection, and an equalizer switch interlocked in the manner specified in clause (*b*) above. The operation of the overload release is to be arranged to isolate both poles simultaneously. In addition, a single-pole "neutral" isolating switch is to be fitted.

(iii) For each generator if compound-wound, the series field winding being split, i.e., half the winding being connected to each pole: a circuit-breaker with overload and reverse-current protection in each "outer" conductor and two single-pole equalizer circuit-breakers interlocked in the manner specified in clause (*b*) above. The operation of any overload or reverse-current trip is to be arranged to isolate all poles and equalizers. In addition, a single-pole "neutral" isolating switch is to be fitted.

(*d*) Where one or more three-phase alternating-current generators are installed:—

For each generator: a triple-pole linked circuit-breaker with overload trips on at least two phases where the system is three-phase three-wire, and with an overload trip on each phase and a "neutral" isolating switch where the system is three-phase four-wire.

10. Main Switchgear for Outgoing Circuits.—Every main switchboard and every emergency switchboard is to be provided with the following switchgear as a minimum for each outgoing circuit:—

A. Two-wire Direct-Current Systems.

(i) If a single-wire or a two-wire earthed system: a fuse and a single-pole switch on the insulated pole.

(ii) If a two-wire insulated system: a fuse on each pole and a double-pole linked switch.

(iii) Where two or more generators, not operating in parallel, are installed: multiple-way switches so controlling each outgoing circuit that the total generating capacity is at all times available for distribution.

B. Three-wire Direct-Current Systems.

(i) For each outgoing three-wire circuit where the supply is given to three conductors: either a double-pole linked circuit-breaker controlling the "outer" conductors, or a fuse on each "outer" conductor and a double-pole linked switch controlling the "outer" conductors.

(ii) For each outgoing two-wire insulated circuit from the "middle wire" and one "outer" of a three-wire system: either a double-pole linked circuit-breaker, or a fuse on each pole and a double-pole linked switch.

(iii) For each outgoing single-wire or two-wire earthed circuit from the "middle wire" and an "outer" of a three-wire system: a fuse and a single-pole switch on the insulated pole.

C. Three-phase Alternating-Current Systems.

(i) For each outgoing three-wire circuit to which a supply is given from the three conductors: either a triple-pole linked circuit-breaker with overload trips on at least two phases, or, where motors are not connected to the circuit, a fuse on each pole and a triple-pole linked switch.

(ii) For each outgoing two-wire insulated circuit to which a supply is given from one of the three conductors and the "neutral": either a double-pole linked circuit-breaker, or a fuse on each pole and a double-pole linked switch.

(iii) For each outgoing single-wire or two-wire earthed circuit to which a supply is given from one of the three conductors and the "neutral": a fuse and a single-pole switch on the insulated pole.

(iv) For each outgoing four-wire circuit used to supply a section board or distribution fuse-board from which three-wire or two-wire circuits are supplied: either a triple-pole linked circuit-breaker with an overload trip in each phase, or a fuse in each phase and a triple-pole linked switch.

11. Prohibition of Fuses and Non-linked Switches in Certain Conductors.—A fuse, non-linked switch, or non-linked circuit-breaker, is not to be inserted in:—

(*a*) The "middle wire" of a direct current or single-phase three-wire circuit.

(*b*) The "neutral" of a three-phase four-wire circuit.

(*c*) The earthed conductor of a single-wire or two-wire earthed system.

12. Isolating Link (three-wire and three-phase circuits).—The requirements of **clauses 10** (*b*) (i), **10** (*c*) (ii) and (iii) and **11**, do not preclude the provision (for testing purposes) of an isolating link having at least as large a current-carrying capacity as the conductor which it is intended to isolate. Such link is to be securely fixed to its terminals by bolts or screws, and is to be used to isolate such conductor only when the other conductors are isolated.

13. Instruments.—Every main switchboard and every emergency switchboard is to be provided with the following instruments as a minimum:—

A. Two-wire Direct-Current Systems.

(i) Where one generator is installed: one ammeter and one voltmeter.

(ii) Where more than one generator is installed, the generators not being arranged to run in parallel: for each generator installed, one ammeter and one voltmeter.

(iii) Where more than one generator is installed, the generators being arranged to run in parallel: an ammeter for each generator, and two voltmeters. A plug or a linked double-pole multiple-way switch is to be provided to enable one voltmeter to be connected to any one generator before the machine is connected to the busbars; and the other voltmeter is to be permanently connected to the busbars. For compound machines the ammeter is to be connected on the positive pole (i.e., the pole opposite to that to which the equalizer connection is made).

B. Three-wire Direct-Current Systems.

Instruments as specified for two-wire systems, and, in addition, a voltmeter connected between the "neutral" and each "outer" busbar.

C. Three-phase Alternating-Current Systems.

Where only one generator is installed, or where more than one generator is installed, the generators not being arranged to run in parallel: for each generator installed, an ammeter in each phase conductor, and one voltmeter.

Where more than one generator is installed, the generators being arranged to run in parallel: an ammeter in each phase conductor for each generator, two voltmeters and a synchronizing device for paralleling purposes. A plug or a linked double-pole multiple-way switch is to be provided to enable one voltmeter to be connected to one phase of any one generator before the machine is connected to the busbars; and the other voltmeter is to be permanently connected to one phase of the busbars. All these voltmeter connections are to be made to the corresponding phase of each generator.

14. Instrument Scales.—The upper limit of the scale of every voltmeter is to be not less than 120 per cent of the normal voltage of the circuit; and the

upper limit of the scale of every ammeter is to be not less than 150 per cent of the current rating of the circuit in which the ammeter is connected.

15. **Earth Testing.**—(*a*) Every main switchboard and every emergency switchboard is, except where one pole is permanently earthed, to be provided with suitable means for indicating the state of the insulation of the system.

(*b*) Where an earth-indicating system using two lamps and/or two voltmeters is adopted, earth-indicating lamps are to be of the metal-filament type each not exceeding 30 watts. The system employing a single lamp is not to be used.

For the special requirement for vessels carrying oil having a flash point below 150° F. (65·5° C.) (*see* Section 15).

NOTE.—To facilitate comparison of the brilliance of earth-indicating lamps they should be of the same colour and should be placed not more than 6 inches apart.

16. **Protection of Essential Services.**—Where the auxiliary machinery is entirely or almost entirely electrically driven, means are to be provided to ensure as far as is practicable a continuous supply of power to essential services.

17. Where required under Board of Trade Regulations the circuit-breakers are to be so arranged that, in the event of overload or partial failure of the supply of power, the non-essential services are interrupted first, and the essential services are maintained by the generator or generators which remain in operation.

NOTE.—The operating or tripping circuits of the generators referred to in clause 17 should, where necessary, be arranged with auxiliary contacts or similar device to ensure that the generators are completely isolated when the circuit-breakers are in the "off" position.

The following settings of over-current and inverse-time-limit devices (expressed as a percentage of the rated current of the generator or cable to be protected) for "preference" systems are preferred :—

	Over-current settings.	TIME DELAYS. Ships with steam prime movers.	Ships with internal-combustion engines
Main generator circuit-breakers ...	50 per cent	20 seconds	10 seconds
Non-essential group circuit-breakers ..	25 per cent	10 seconds	5 seconds

The time delays for relays or other similar devices for opening non-essential group circuit-breakers should preferably be as follows :—

	TIME DELAYS. Ships with steam prime movers.	Ships with internal-combustion prime movers.
First non-essential group	5 seconds	2 seconds
Second non-essential group (if any)	10 seconds	5 seconds
Third non-essential group (if any)	15 seconds	8 seconds

Circuits to electrically-driven machinery essential for the preservation of the perishable cargo should be included in the last group to be disconnected.

18. **Over-Current Protective Devices.**— Devices for protection against over-current and short circuit are to be of the type shown in the following schedule :—

Current rating of generator or cable protected by device.	Type of device to be used.
Up to 200 amperes	Fuse or circuit-breaker
201 to 300 amperes	Fuse or circuit-breaker*
Above 300 amperes	Circuit-breaker

***It is recommended that a circuit-breaker be used in preference to a fuse.**

19. **Switches and Circuit-Breakers.**—Each switch, switch-fuse and circuit-breaker is to comply with the following requirements :—

(*a*) The maximum total temperature of all current carrying parts, with the exception of coils, is not to exceed 70° C. (158° F.) for devices rated up to 2,000 amperes and 80° C. (176° F.) for devices rated above 2,000 amperes; and the temperature rise is not to exceed the following values :—

Rating.	Maximum Temperature Rise. Open Type.	Totally Enclosed.
Up to 100 amperes	20° C. (36° F.)	30° C. (54° F.)
101 to 2,000 amperes	30° C. (54° F.)	30° C. (54° F.)
Above 2,000 amperes	40° C. (72° F.)	40° C. (72° F.)

(*b*) The maximum total temperature and temperature rise of operating coils is not to exceed the values shown in the following table :—

Insulating Material.*	Total Temperature. Continuously Rated °C.	Int'rmittently Rated °C.	Maximum Temperature Rise. Continuously Rated °C.	Int'rmittently Rated °C.
Class A	90	100	50	70
Class B and Bare Coils	120	130	100	100
Class D	100	110	70	80
Thermal-tripping devices	200	—	160	—

* For complete definition of these classes of insulating material see appendix 2.

(*c*) All stem connected switches are to have the contacts and hinges dowelled or otherwise locked to prevent their getting out of alignment by rotation on the panel.

(*d*) The minimum number of connection nuts for each stud is to be two, but if a nut is required for clamping the part to the base, a third nut is to be supplied in addition.

(*e*) Every switch is to be capable of breaking a load current 50 per cent in excess of its rated current at rated voltage, 100 times for switches rated up to 60 amperes, and 10 times for larger switches, and be capable of being put into service at the conclusion without injurious overheating.

(*f*) Every circuit-breaker is to be so adjusted that it will open the circuit when a current flows equal to twice (or less than twice) the rating of the smallest cable or bare conductor it is installed to protect, provided that this requirement is not to apply to a motor circuit installed in accordance with Section 5, clause 2 (*b*).

NOTE.—It is preferred that the over-current setting of a circuit-breaker (expressed as a percentage of the current rating of the cable which it protects) should be in accordance with the appropriate item in the following Schedule :—

	Over-current settings
Continuously rated circuits	25 per cent
Generator circuits and intermittently rated circuits	50 per cent
Steering-gear circuits and emergency circuits ...	100 per cent

(*g*) Where reverse-current protection is provided the device is to operate at not more than 15 per cent. of the rated full-load current of the generator with rated voltage across the potential coil, at any permissible temperature within the working range.

The action of the reverse-current mechanism is not to be rendered inoperative by a reverse current of excessive value provided the applied voltage is not reduced by more than 50 per cent. A fall of 50 per cent. in the applied voltage is not to render the device inoperative, but it may alter the amount of reverse current required to open the breaker.

(*h*) Every circuit-breaker rated at more than 15 amperes is to be of the free-handle type, and is to be provided with suitable means of adjustment for determining the current at which it is to open the circuit. Every circuit-breaker rated at 100 amperes and above is to be fitted with an inverse-time-limit over-current release.

(*i*) Every circuit-breaker is to be so constructed that, irrespective of the method of tripping and the conditions of load, it will when operated break the circuit effectually and without undue arcing.

(*j*) Circuit-breakers are to be so arranged and placed that no inflammable material is endangered by their coming into action, and that the arc cannot reach earthed metal.

(*k*) Where the current to be interrupted by a switch or circuit-breaker is of such magnitude as to cause damage to the contacts, suitable arrangements are to be made for the easy renewal of the damaged parts, without requiring the removal of the apparatus from its place.

(*l*) The handles and operating mechanisms of switches and circuit-breakers are to be mechanically strong, and are to be so designed and arranged that the hand of the operator, when using the device, cannot accidentally touch live metal or be injured through an arc arising from the switch or circuit-breaker or the blowing of an adjacent fuse. If switches are enclosed, their handles are not to operate through unprotected slots.

(*m*) Where switches are not fixed on a switchboard, the live parts are to be enclosed by covers of non-ignitable material. In positions in which they are liable to mechanical injury the covers are to be of rigid metal or are to be protected by a suitable guard. In other positions the covers may be either of rigid metal or non-conducting material. Metal cases are to be well clear of live parts, and where the switches are of the open type and are rated for currents exceeding 6 amperes at voltages exceeding 125 volts the cases are to be lined in way of the arc with non-ignitable material.

(*n*) All switches fixed in positions exposed to the weather, to drip, or to an excessively moist atmosphere, are to be contained in weatherproof cases which are to be provided with cable glands or bushings, or be adapted to receive screwed conduit, according to the way in which the cables entering these fittings are run.

(*o*) Each circuit-opening device is to be so constructed and arranged that when placed in the "off" position it cannot accidentally move sufficiently to close the circuit.

20. **Fuses.**—(*a*) Every fuse is to comply with the requirements of Appendix No. 5, and the choice from the categories of duty referred to in the Appendix is to be made with regard to the prospective short-circuit current and the total output of the generators feeding the circuit in which the fuse is connected.

(*b*) Details of the construction and tests for rupturing capacity and temperature rise of fuses are to be submitted for approval and only approved types of fuse are to be installed on switchboards, section boards and distribution fuse-boards.

(*c*) Each fuse is to be permanently and indelibly labelled with the current carrying capacity of the circuit or generator protected by it and with the appropriate approved size of fuse or replaceable element.

(*d*) The current rating of a fuse-element is not to exceed the current rating of the smallest cable in the circuit protected by the fuse-element, provided that this requirement is not to apply to a motor circuit installed in accordance with Section 5, clause 2 (*b*). Table XII gives approximate fusing currents for wires of copper and standard eutectic tin-lead alloy.

(*e*) Every fuse is to be provided with a suitable non-ignitable insulating fuse-carrier of such form as to protect a person handling it from shock and burns.

(*f*) Effectual provision is to be made for retaining in position all fuses subjected to vibration or shock.

(*g*) Where fuses are not fixed on a switchboard they are to be grouped on section boards or distribution fuse-boards, or are to be contained within cases conforming in all respects to the requirements laid down in clause 21.

(*h*) Fuses are not to be placed in socket-outlets, plugs, or ceiling-roses.

21. Section Boards and Distribution Fuse-boards.—(*a*) Section boards and distribution fuse-boards are to be constructed in accordance with clauses 2 and 3 above, so far as they are applicable, and the fuses fitted on such boards shall conform to clause 20 above.

(*b*) Every section board and distribution fuse-board is to be contained within a protecting case, unless of such size that it is contained in a separate compartment or space in the ship. Cupboards or compartments containing switchboards are to be composed of, or lined with, non-ignitable material.

(*c*) Cases are to be of ample mechanical strength and rigidity and metal cases are to be protected from corrosion. Ample space for wiring is to be provided.

(*d*) Cases are to be of metal, except in passenger and other accommodation, and in crew spaces, where they may be of wood.

(*e*) Where the case is of metal the minimum distance in air between live metal and the case is to be not less than $\frac{1}{2}$-inch independent of any displaceable insulation, whether bushing or barrier, and not less than $\frac{3}{4}$-inch when measured over the surface of any non-displaceable insulation. The clearance between arcing contacts or fuses and unlined cases is to be such that operation within the rating of the switch, fuse or circuit breaker can be carried out satisfactorily.

(*f*) Soft-wood cases are to be lined with non-ignitable material. Cases of hard wood such as teak, English oak or mahogany need not be so lined. The lining or hard wood case is to be clear of live parts by not less than $\frac{1}{2}$-inch.

(*g*) Cases not provided with backs forming an integral portion thereof are to have a non-ignitable insulating shield between their contents and the bulkhead or any other structure to which they are fixed.

(*h*) Where glass fronts are provided, the glass is to be of the "wired" type and the fronts are to clear all live parts by not less than $\frac{3}{4}$ inch. Where the boxes are of metal, such fronts may be regarded as insulating shields.

(*i*) Cases fixed in positions exposed to the weather, to drip, or to an excessively moist atmosphere, are to be weatherproof and provided with cable glands or bushings, or be adapted to receive screwed conduit, according to the way in which the cables entering these fittings are run.

22. Joint and Junction Boxes.—Joint and junction boxes are to be constructed wholly of durable, non-inflammable, non-absorbent materials, and all insulation is to be of permanently high electric strength and insulation resistance. The live parts are to be so arranged, by suitable spacing or shielding with non-inflammable, insulating materials, that conductors of opposite polarity or different phase cannot readily be short-circuited. If used in damp situations, such boxes are to be watertight.

DISTRIBUTION.

Section 4. 1. Every distribution fuse-board is to be directly connected to one of the following:—

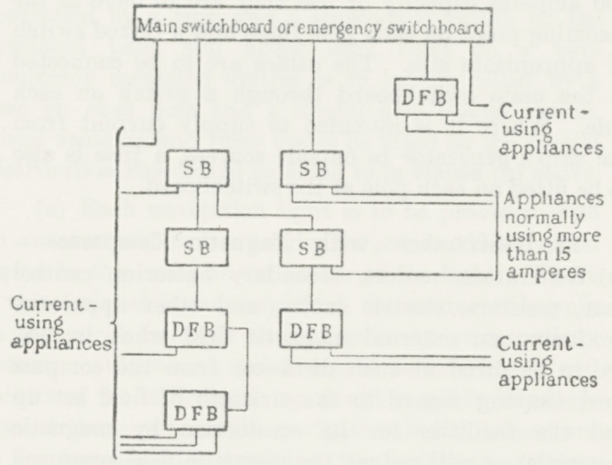
(*a*) The main switchboard or emergency switchboard.

(*b*) A separate way on a section board.

(*c*) A circuit feeding several distribution fuse-boards either by looping-in to their busbars or in the form of a ring main. Fuse-links or disconnecting links may, if desired, be inserted in these connecting cables. Such circuit is itself to be connected to one way of the main switchboard, emergency switchboard, or section board. Where a reduction is made in the

cross-sectional area of a conductor, protection is to be provided in compliance with the requirements of Section 6, clause 10.

NOTE.—The sequence shown in the following diagram is recognized as standard. The number of intermediate boards intervening between the final sub-circuit and the main switchboard or emergency switchboard will depend upon the size and disposition of the installation.



SB = Section board; DFB = Distribution fuse-board.

2. **Protection Against Excess Current.**—Throughout an installation every circuit is, except as prohibited under clause 3 (*c*), to be protected on each insulated pole by a fuse or circuit-breaker.

3. **Control of Circuits.**—(*a*) Every outgoing circuit from a section board or a distribution fuse-board is to be controlled by a fuse on each insulated pole, and every two-wire circuit rated at more than 100 amperes is, in addition, to be controlled as a minimum by a switch on one insulated pole.

(*b*) Every three-wire circuit supplied from all three conductors of a three-phase system is to be controlled by a triple-pole linked circuit-breaker with overload trips on at least two phases, or, except in circuits supplying motors, by a triple-pole linked switch and by a fuse on each pole.

(*c*) A fuse, non-linked switch, or non-linked circuit-breaker, is not to be inserted in that pole of the circuit which is either earthed or derives its polarity from an earthed conductor, but an isolating link securely fixed to its terminals by bolts or screws may be fitted for testing purposes.

NOTE.— Requirements for the control of outgoing circuits from main switchboards and emergency switchboards are contained in Section 3, clause 10.

4. **Earth Return.**—Only ships having steel hulls are to be wired on the single-conductor system; hence such system shall not be used on composite ships.

5. **Earthing of Neutral.**—(*a*) Where the distribution is effected on the three-wire direct-current system, or three-wire or four-wire three-phase alternating-current system, whatever the voltage of supply, the neutral may, if desired, be earthed.

(*b*) Where the voltage exceeds 250 volts across the outers of a three-wire system, the neutral is to be solidly and permanently earthed at one point at least.

6. **Earthing Connections.**— (*a*) Every earthing lead (other than those provided for in clause (*b*) below) is to be of stranded or solid phosphor bronze or high-conductivity copper, and is to be protected wherever exposed to the likelihood of mechanical damage, and also, where necessary, against corrosion, particular attention being given in these respects to the point of connection to the hull of the ship. The nominal cross-sectional area of such earthing lead is to be not less than 0·007 square inch for every 50 amperes of working current, provided that its sectional area is in no case less than 0·0045 square inch and is the same as the sectional area of the working conductor for all sizes up to 0·007 square inch. Its sectional area need not exceed 0·1 square inch. The nominal cross-sectional area of every phosphor-bronze earthing lead is to be such as to provide a current-carrying capacity not less than that which would be required for a copper earthing lead.

NOTE.—Where earthing leads are exposed to the weather it is preferred that phosphor bronze be used in preference to copper.

(*b*) Every conductor used to carry the working current of a circuit to the ship's structure on the single-conductor system of distribution is to have a cross-sectional area not less than that of the corresponding conductor of the insulated portion of the circuit.

(*c*) Every connection to the ship's structure is to be in an accessible position, and is to be secured by a brass screw of not less than $\frac{3}{8}$ inch diameter used for this purpose only. Where a cable socket is not used (*see* Section 9, clause 1) the wires are to be formed into a hook and placed under a tinned brass washer. In all cases care is to be taken to ensure bright metallic surfaces at the contact areas immediately before screwing up.

7. Two-wire Circuits above 250 Volts.—Where the voltage exceeds 250 volts, the following conditions are to be observed :—

(*a*) Motors only are to be supplied at such higher voltage. No motor of 3 brake horse-power or less, and no portable motor of any size, is to be supplied at such higher voltage.

(*b*) All exposed metalwork, other than that designed to be live, is to be effectually connected to earth.

(*c*) All apparatus is to be so constructed, enclosed, and protected, that there shall be no danger of shock in the ordinary handling thereof.

NOTE.—Requirements for generators, motors, and cables, for voltages exceeding 250 volts are contained in Sections 2, 9, and 12.

8. Three-Wire Circuits above 250 Volts.—Where three-wire distribution is employed and the voltage across the outer conductors exceeds 250 volts, the voltage between any two points in one space or compartment where portable fittings, appliances, or accessories are likely to be used is not to exceed 250 volts, unless the fittings, appliances, or accessories, between which there may be a higher voltage, are so situated that they cannot be brought within 1,8 m. of each other.

9. Alternative Lighting in Engine Rooms, etc.—In engine rooms and boiler rooms, and in the corridors and stairways leading to the boatdecks of passenger ships, alternate groups of lamps are to be supplied from circuits so arranged that the melting of any one fuse-element (other than a fuse-element on the main switchboard) will not leave these spaces in darkness.

10. Emergency Supply.—Where the Board of Trade require an emergency supply to be provided, it is to be adequate in amount, and so disposed as to meet all requirements concerning safety imposed by the Board of Trade. Emergency circuits are to be connected direct to a change-over switch or switches, which are to be fitted on the emergency switchboard only, to enable such circuits to be quickly transferred from the ordinary source of supply to the source of emergency supply. Where an emergency battery is installed, an indicator is to be provided and is to be arranged to show whether the battery is in service. The indicator should preferably be mounted on the main switchboard.

11. Shore Connections.—Where provision is required for a supply of electrical energy from a source on shore or other external source, a suitable connection box or boxes is to be fitted in a position convenient for the reception of portable cables from the external source, and containing terminals of ample size and of such form as to enable the conductors to be effectually clamped therein. The terminals are to be connected to the main switchboard by suitable cables permanently fixed. Where the cables are of 300 amperes capacity or less they are to have at the incoming point on each pole fuses and a linked switch of appropriate size. The cables are to be connected to the main switchboard through a switch on each pole. Where it is intended to supply current from the ship's generator to outside sources, a fuse is also to be fitted on each pole at the switchboard.

12. Interference with Magnetic Compasses.—(*a*) Generators, motors, secondary batteries, control gear, resistors, electric cables, and other apparatus producing an external magnetic field when in use, are to be fitted at such distances from the compass bowl (having regard to the strength of field set up and the facilities for its conduction by magnetic materials) as will reduce the magnetic field produced by such apparatus to a negligible value thereat.

NOTE.—It is recommended that the devices and apparatus, referred to in clause 12 above, should never be less than 10 feet distant from any magnetic compass.

(*b*) A single-conductor direct-current circuit is not, in any instance, to be fitted within 30 feet of standard and steering compasses. In order that the lead and return currents in such circuit shall neutralize one another in two-conductor systems, cables in the vicinity of the compass are preferably to be twin; and single-core cables are to be fixed as close to one another as possible, and are to be equidistant from the compass throughout their length. Cables within the compass binnacle are to be as short and direct as possible; and where such cables are single-core, they are to be twisted together and are not to be coiled into spiral loops.

(*c*) The current input of incandescent electric lamps employed for illumination of the compass card is not to exceed 0·6 ampere. Such lamps are to be so placed that no live part is less than 7 inches from any part of the magnetic system of the compass.

(*d*) Careful tests are to be made during the adjustment of the compasses. The effect of switching on and switching off circuits, motors, and other electro-magnetic apparatus, near the compasses is to be noted, and careful records kept of any errors observed, whether corrected or not.

13. **Navigation Lights.** — (*a*) Each navigation light is to be separately wired from a special distribution fuse-board which is not to supply any other group. This distribution fuse-board is to be placed in a position accessible to the officer of the watch.

(*b*) Each navigation light on a single-conductor system or a two-conductor earthed system is to be controlled by a fuse and a single-pole switch on the insulated pole, and every such light on a two-conductor insulated system is to be controlled by a fuse on each pole and a double-pole linked switch. These switches and fuses are to be fitted on the special distribution fuse-board referred to in clause (*a*) above.

(*c*) Each navigation light is to be provided with an automatic indicator to give an aural and/or visual signal in the event of extinction of the light. Where a visual signal is not employed, the source of supply to the aural device is to be a primary or secondary battery. Where a visual signal is employed and failure of the indicator lamp would result in interruption of the supply to the navigation lights, means are to be provided for bridging the indicator contacts until the faulty lamp is replaced.

NOTE.—Clause 13 (*c*) does not apply to tugs, trawlers, or fishing and similar small vessels.

The indicator referred to in clause 13 (*c*) may, if desired, be combined with the special distribution fuse-board specified in clause 13 (*a*).

The efficiencies of navigation lamps are based on a voltage drop in series indicating devices up to 3 per cent of the rated voltage of the circuit.

(*d*) In the event of failure of the circuit supplying the navigation lights, it is to be possible on the bridge to change them over to an alternative circuit.

(*e*) The permanent circuit to each navigation light is to terminate in a watertight connection box adjacent to the lantern, and the lamp is to be provided with a short length of flexible cable, securely anchored, for connection to the watertight box, subject to the exception that for mast-head lights a watertight plug and socket may, if desired, be used as an alternative.

(*f*) On single-wire systems every navigation light is to be wired from the distribution fuse-board with two insulated conductors, the earth connection being made at an earth point in the distribution fuse-board.

14. **Control of Electric Lift Circuit.**—(*a*) Circuits which supply current to the motor operating an electric lift or hoist are not to be included in any twin or multicore trailing cable used in connection with the control and safety devices of the lift or hoist; and they are not to be connected to a distribution fuse-board controlling final sub-circuits for lighting unless the maximum current (including the starting or accelerating current) of the motor is less than 20 per cent of the total rating of the fuse-ways on the distribution fuse-board, and unless the fuse-way of the motor circuit is clearly labelled.

(*b*) A twin or multicore trailing cable which is used in connection with an electric lift or hoist, and which incorporates any conductor of any circuit operated at the supply voltage, is not to include any conductor of an electric bell or similar signalling circuit which is operated at reduced voltage from the supply system, or which is energized from another source.

15. **Steering Gear.**—Where the two independent steering gears are both driven by electric or electro-hydraulic power they are to be supplied by two independent circuits and a change-over switch is to be fitted in the steering compartment or other approved position to enable the supplies to be interchanged. Each circuit is to be connected direct to the main switchboard, except that where an emergency generator is fitted one circuit is to be connected to the emergency switchboard, but arranged normally to be supplied from the main switchboard.

The cables for each circuit are to be led by independent routes so that, as far as practicable, damage to one does not involve the other.

THE ARRANGEMENT OF FINAL SUB-CIRCUITS.

Section 5. 1.—(*a*) Every final sub-circuit is to be connected to a separate way on a distribution fuse-board or section board, or to the main switchboard or emergency switchboard.

(*b*) A final sub-circuit having a rated capacity not exceeding 15 amperes may supply any number of points up to ten. A final sub-circuit having a rated capacity exceeding 15 amperes is not to supply more than one point.

(*c*) In cornice lighting, panel lighting, and electric signs, where lampholders are grouped in close proximity to each other and are connected to the circuit without flexible cords, each lampholder is not, for the purposes of clause (*b*) above, to be deemed to be one point. In these circumstances more than 10 lampholders may, if desired, be connected to a final sub-circuit, provided that the maximum working current in such sub-circuit does not exceed 10 amperes.

NOTE.—Where a circuit for a pilot lamp in connection with a current-using appliance is connected through a local fuse or fuses to the final sub-circuit supplying the appliance, such pilot-lamp is not, for the purposes of these Rules, deemed to be a final sub-circuit.

2. **Protection against Excess Current.**—(*a*) Every final sub-circuit is, except as prohibited under Section 4, clause 3 (*c*) to be protected on each insulated pole by a fuse or circuit-breaker.

(*b*) Where the starting or accelerating current of a motor considerably exceeds the rated full-load current, the current at which the circuit-breaker is adjusted to operate, or the current rating of the fuse-element (or fuse elements) protecting the motor, may exceed by not more than 50 per cent that required for compliance with Section 3, clauses 19 (*f*) and 20 (*d*) for the protection of a cable rated for the full-load current of the motor; and the fuse containing such fuse-element is to be of the appropriate rating.

(*c*) A fuse smaller than one rated for a normal working current of 3 amperes need not be inserted in any final sub-circuit.

3. In every installation the lighting circuits are to be supplied by final sub-circuits separate from the circuits for heating and power requirements.

4. **Control of Final Sub-Circuits.**— (*a*) Every two-wire circuit rated at more than 100 amperes is to be controlled as a minimum by a switch on one insulated pole.

(*b*) Every three-wire circuit supplied from all three conductors of a three-phase system is to be controlled by a triple-pole linked circuit-breaker with overload trips on at least two phases, or by a fuse on each pole and, for circuits rated at more than 60 amperes, by a triple-pole linked switch.

CONDUCTORS.

Section 6. 1. **Standard Sizes.**—The sizes of conductors shown in Tables I, II, and IV, are recognized as standard for ship installations.

2. **Material.**—(*a*) All conductors of cables are to be of annealed copper having an elongation of at least 15 per cent when determined by a test piece not less than 6 inches nor more than 12 inches long and conforming in all other respects to the Standards of the International Electrotechnical Commission Publication No. 28.

(*b*) Where the insulating covering of the conductor of a cable is composed of vulcanized rubber, each wire is to be effectually and uniformly coated with tin free from all impurities, and the tinned conductor of the finished cable is to be capable of withstanding the tinning test set out in Appendix 7.

(*c*) Where the insulating covering of the conductor of a cable is cambric impregnated otherwise than with a bituminous-base compound, an effective separating tape is to be inserted between the cambric and the lead-alloy sheathing, and, where the conductor is not tinned in compliance with clause (*b*) above, also between the cambric and conductor.

(*d*) All busbars, busbar connections, and bare conductors, are to comply with the requirements of the appropriate clauses, Appendix 7. Aluminium is not to be used.

3. **Minimum Size of Conductor.**—The smallest conductor for fixed wiring is to have a normal cross-sectional area of not less than 0·0015 square inch.

4. **Maximum Size of Single Wire.**—All conductors, except earth continuity conductors, of cable having a nominal cross-sectional area exceeding 0·003 square inch (1/·064 in.) are to be stranded.

5. **Current Carrying Capacity of Cables.**—Every conductor of a cable (other than a flexible cord or flexible cable, for which see Section 8) is to be capable of carrying, without the respective ratings set out in Tables I and II inclusive being exceeded, the maximum current which will normally flow through it, provided that:—

(*a*) For final sub-circuits a diversity factor is not to be applied.

(*b*) For circuits other than final sub-circuits a diversity factor may be applied, provided that the known or anticipated conditions are suitable for the application of diversity.

Note.—It is impossible to specify in these Rules the value of the diversity factor for every type of installation. For the application of diversity to circuits supplying cargo-winches, cranes, windlasses, and capstans, see clause 6 below.

(*c*) For an electric motor, the maximum current is to be deemed to be the full-load rated current of the motor, and, unless the actual current be known, is to be taken to correspond to the values given in Table XIII for the types referred to therein. For motor outputs between those shown in the Table, the full-load current is to be taken to be directly proportional to the output and is to be calculated from the next lower output given in the Table.

(*d*) Where the load on a cable is intermittent, the cable is permitted to carry a larger current (subject to voltage drop) than if continuously loaded. Table III gives the maximum permissible currents for

half-hour and one-hour ratings. In no case is a shorter rating than one half-hour to be taken whatever may be the degree of intermittency.

(*e*) In assessing the current rating of lighting points for the purpose of determining sizes of conductors, every lampholder is to be deemed to require a current equivalent to the maximum load which is likely to be connected to it, which is, except for the circuits described in **Section 5, clause 1** (*c*), to be assumed to be at least 60 watts, provided that where the lighting fitting is so constructed as to take only a lamp smaller than 60 watts the conductors may be assessed accordingly.

6. **Circuits for Cargo-Winches, Windlasses, etc.**—(*a*) Cables for the motors of cargo-winches, cranes, windlasses, and capstans, are to be suitably rated for the duty intended, and, unless the duty is such as to require a longer rating, cables for winch motors may, if desired, be half-hour rated (subject to voltage drop) based on the maximum brake-horse-power ratings of the motors. Cables for windlass motors and capstan motors are to be not less than one-hour rated (subject to voltage drop) based on the maximum brake-horse-power ratings of the motors.

(*b*) A diversity factor may, if desired, be applied in calculating the cross-sectional areas of cables supplying groups of cargo-winch motors or crane motors, subject to such factor being based on the proposed duty of the motors and on currents as required by **Table XIV**. Such cables are to be capable of carrying continuously the current calculated by applying the diversity factor to the total connected load of winch motors and crane motors. Where the cables feeding winch motors and/or crane motors supply, in addition, other equipment, the current upon which the size of the cable is based is to be computed with due regard to the coincidence of the various loads.

7. **Equalizer Connections.**—Every equalizer connection for use with flat-compounded generators is to have a sectional area of at least 50 per cent of the sectional area of the positive and negative connections to the generator.

NOTE.—To assist proportionate sharing of the load by parallel-connected generators, it is recommended that where the lengths of the connections or the rated sizes of the generators are different the section areas of the equalizer connections should be so graded as to ensure that the voltage drop in all of them is equal at full load.

8. **Cables for Alternating Current.**—If armoured single-core cables are used for alternating current circuits the armouring is to be of non-magnetic material.

9. **Voltage Drop.**—The size of conductors is to be so selected that the fall of voltage between the main switchboard busbars and any and every point on the installation, when the conductors are carrying the maximum current under the normal conditions of service, does not exceed 6 per cent of the voltage at the busbars for power, heating and lighting circuits, and 1 volt plus 1 per cent. of the voltage at the busbars for radio apparatus mains when carrying the main and battery-charging loads simultaneously.

NOTE.—Where an independent charging circuit is provided for the radio battery, the last words of clause 9 apply only to the radio-apparatus mains.

10. **Relative Sizes of Conductor and Fuse-Link.**—In each circuit every cable is to have a current rating not less than that of the fuse-element (or the adjustment of the circuit-breaker) protecting the circuit. Where a reduction in cross-section is made to a conductor, e.g., at an extension or branch thereof, the smaller conductor is to be protected locally by a circuit-breaker or fuse-element of the appropriate rating (*see* **Section 3, clauses 19** (*f*) and **20** (*d*) and **Tables I** to **IV**) except where the adjustment of the circuit-breaker or the rating of the fuse-element protecting the larger conductor does not exceed the rating of the smaller conductor.

THE INSULATION AND PROTECTIVE COVERING OF CABLES.

Section 7. 1.—Only the following types of cables, which may be single-core, twin, or multicore, are to be employed:—

(*a*) Vulcanized-rubber-insulated cables:—

(i) Taped, braided and compounded.

(ii) Lead-alloy-sheathed (with, if desired, braiding over the lead).

(iii) Lead-alloy-sheathed and armoured (with, if desired, braiding over the armour).

(iv) Vulcanised-rubber-sheathed ("H.R." type). Varnished-calico taped, braided, and compounded with fire-resisting compound; and complying with special test requirements.

(*b*) Impregnated-paper-insulated cables and varnished-cambric-insulated cables:—

(i) Lead-alloy-sheathed (with, if desired, braiding over the lead).

(ii) Lead-alloy-sheathed and armoured (with, if desired, braiding over the armour).

2.—Where it is desired to use types of cables insulated otherwise than specified in **clause 1** above, sample lengths are first to be submitted for approval, each sample being accompanied by a report from a recognized testing authority regarding the behaviour, properties, and life, of the insulating materials employed.

3. Twin-core and three-core cables are to be circular, i.e., flat-sided cables are not to be used.

4. **Vulcanized - Rubber - Insulated Cables.** — (*a*) Vulcanized-rubber-insulated cables are to be insulated with two or more layers of vulcanized rubber which, except in single-core vulcanized-rubber-sheathed cables ("H.R." type) are to be covered with a helical binding of a high-quality cotton tape proofed on one side with rubber and applied before vulcanization, with a suitable overlap. The whole is to be vulcanized together and is to form a compact homogeneous body; it is not to be possible to separate the layers of rubber, but the tape is to be removable without tearing the rubber. The thickness of the insulation is to be in accordance with the appropriate **Table V or VI.**

(*b*) Braided cables are to have a fibrous braiding, thoroughly impregnated with a preservative compound of such a nature as not to have any deleterious action on the rubber or armouring as the case may be. The finish of the braiding is to be smooth and uniform.

(*c*) The interstices between the cores of twin and multicore rubber-insulated cables are to be filled with jute or rubber and a rubber-proofed cotton tape is to be applied with a definite overlap over the laid-up and filled cores.

5. **Impregnated - Paper - Insulated Cables.**—(*a*) Impregnated-paper-insulated cables are to be insulated with layers of paper impregnated with a chemically neutral insulating compound. The paper is to be manufactured from chemical wood-pulp fibre and is to be uniform in texture, strong, long fibred, free from imperfectly pulped materials, metallic particles or deleterious substances. It is not to contain mechanical wood, straw, esparto, or any other low-grade fibrous materials. The thickness of the insulation is to be in accordance with the appropriate **Table VII or VIII.**

(*b*) The insulated cores of multicore impregnated-paper-insulated cables are to be laid up with a suitable lay, the interstices are to be filled with paper or jute, and the cable is to be sheathed with lead alloy, in accordance with **clause 6.**

6. **Varnished - Cambric - Insulated Cables.**—(*a*) Varnished-cambric-insulated cables are to be insulated with layers of suitable high-quality varnished-cloth tape or strip, free from wrinkles, blisters, and other imperfections. A viscous, non-drying, and insulating compound is to be used for lubricating and sealing the layers of the varnished cambric. The compound is to be of a mineral base and is not to dry out or deteriorate. The compound is not to drip from the end of a three-foot length of the cable when suspended in a vertical position for 48 hours at a temperature of 170° F. (77° C.). The thickness of the insulation is to be in accordance with the appropriate **Table VII or VIII.**

(*b*) The insulated cores of multicore varnished-cambric-insulated cables are to be laid up with a suitable lay, and the interstices are to be filled with impregnated jute or other suitable filling material.

7. **Lead - Alloy Sheathings.** — (*a*) Lead - alloy-sheathed cables are to be provided with a closely fitting sheath of uniform thickness, free from flaws, and having a smooth exterior surface. The metal of the sheath is to be of alloy A, alloy B or alloy E specified below.

Alloy.	Composition (percentage by weight).						
	Tin.		Cadmium.		Antimony.		Lead
	Min.	Max.	Min.	Max.	Min.	Max.	
Alloy A	1·8	2·2	—	—	—	—	The remainder
„ B	0·35	0·45	0·12	0·18	—	—	
„ E	0·35	0·45	—	—	0·15	0·25	

The lead used in these alloys is to have a lead content of not less than 99·90 per cent, and the impurities, including zinc and bismuth, are not to exceed 0·10 per cent. Zinc is not to be present in an amount exceeding 0·002 per cent, nor bismuth in an amount exceeding 0·05 per cent. No scrap is to be used other than that derived from the cable maker's own manufacture.

(*b*) The radial thickness of lead alloy sheathing is not to fall below the value specified in the appropriate Tables (see **Tables V, VI, VII and VIII**) by more than 10 per cent plus 10 mils.

8. **Armouring.**—Armoured lead-alloy-sheathed cables are to have over the sheath a layer of hessian tape or other suitable material impregnated with a moisture-resisting preservative compound. On the bedding is to be applied an armouring of annealed and galvanized steel wire. The wires are to have a uniform lay of approximately 10 times the diameter of their pitch circle for wires exceeding 0·08 inch diameter, and of approximately 8 times the pitch circle diameter for wires of 0·08 inch diameter and all smaller sizes. The armouring is to be so applied as to present a uniform cylindrical exterior surface. The diameter of armouring wire is to be as specified in **Tables V, VI, VII, VIII** and **IX**, and the thickness of the bedding, measured before the armouring is applied, is to be in accordance with **Table IX.**

9. "H.R." Type Cable.—"H.R." type cable is to consist of a rubber insulated core having a sheath of special oil-resisting rubber compound, taped and braided and treated with a flame-resisting compound. Suitable type tests are to be carried out and the results submitted for consideration. Only approved makes are to be used.

10. **Multicore Cables.**—All the stipulations contained in these Rules relating to quality, dimensions, and tests, of single-core cables are, so far as they apply, to govern the construction of twin and multicore cables.

11. **Contactor Coil Circuits.**—The insulation of cables for contactor operating circuits is, as a minimum, to be 660 volt grade.

12. **Testing and Inspection.**—The prescribed tests and inspections are to be made at the place of manufacture prior to despatch and may be required to be carried out under the supervision of the Surveyor; but, in the event of any of the material proving unsatisfactory in the course of being installed in vessels, such material shall be rejected, notwithstanding any previous certificate of satisfactory testing.

13. **Tests of Dielectric of Cables.**—(*a*) A voltage test is to be carried out on all cables at approximately room temperature with alternating current of sine wave form at a frequency between 25 and 100 cycles per second, and the root mean square of the voltage is to be as stated below for the appropriate grades of cable and maintained continuously at the full voltage for 15 minutes. The voltage test is to be made on the insulated core at the manufacturer's works after the core has been immersed in water for not less than 12 hours, and while still immersed, except that lead sheathed cables need not be so immersed. The voltage is to be applied between the conductor and the water or lead sheath, which is to be earthed, and between the conductors of twin and multicore cables.

VOLTAGE TESTS ON CABLES.

Grade.	A.C. Test voltage applied for 15 minutes.
	Volts.
250 volt cables and flexible cords	1,500
660 volt cables and flexible cords	3,500
1,000 volt cables	3,500
3,300 volt cables	10,000
3,300 volt cables for systems having the centre point earthed	5,800*

*Applied between conductors and earth.

(*b*) The insulation resistance between the conductor and the water in which the insulated core is immersed, or between the conductor and the lead sheath, for vulcanized-rubber-insulated cables is not to be less than the values given in **Table X.** The temperature of the water is to be at or near 60° F. (15·6° C.). When the temperature is not exactly 60° F. (15·6° C.) the result obtained is to be corrected by the appropriate constant given below.

TEMPERATURE CORRECTION FOR INSULATION RESISTANCE.

Temperature °F.	Multiplier Constant	Temperature °F.	Multiplier Constant
1	2	3	4
50	0·773	60	1·000
51	0·793	61	1·026
52	0·814	62	1·053
53	0·836	63	1·080
54	0·857	64	1·108
55	0·880	65	1·137
56	0·902	66	1·167
57	0·926	67	1·198
58	0·950	68	1·229
59	0·975	69	1·261
		70	1·293

The measurement of insulation resistance is to be made after one minute's electrification with direct current at not less than 500 volts.

THE INSULATION AND PROTECTIVE COVERING OF FLEXIBLE CORDS AND FLEXIBLE CABLES.

Section 8. **1. Types of Flexible Cords and Flexible Cables.**—Flexible cords and flexible cables, other than those dealt with in **clause 3**, and **Section 15**, **clause 6** (*e*), are to be provided with one of the following protective coverings:—

(*a*) Natural or self-extinguishing artificial silk braiding.

(*b*) Glacé cotton braiding.

(*c*) Fibrous braiding, thoroughly compounded.

(*d*) Hard cord braiding in addition to the covering specified in (*c*) above.

(*e*) Tough rubber sheathing applied directly to the laid-up insulated cores, with or without braiding.

2. Flexible cords and flexible cables are to, except as provided for in **clause 3**, comply with such clauses of **Section 7** as are applicable.

3. Where the conductor temperature exceeds 150° F. (65·5° C.) but does not exceed 176° F. (80° C.), flexible cords for connection to immersion and other heaters are to be one of the following types:—

(*a*) Flexible cords having the conductor insulated with heat-resisting rubber, asbestos roved, and cotton or asbestos braided overall.

(*b*) Flexible cords having the conductor roved with asbestos, insulated with varnished cambric, asbestos roved, and cotton or asbestos braided overall.

(*c*) Flexible cords having the conductor insulated with varnished cambric, asbestos roved, and cotton or asbestos braided overall.

NOTE.—Types (*b*) and (*c*) above are suitable for use in dry situations only.

4. Current Rating of Flexible Cords and Cables.—Flexible cords and flexible cables are to be capable of carrying, without the respective ratings set out in **Table IV** being exceeded, the maximum current which will normally flow through them.

5. Earth Continuity Conductor in a Flexible Cord or Flexible Cable.—(*a*) The earth continuity conductor in a flexible cord or flexible cable is to be insulated.

(*b*) In a flexible cord having conductors of a nominal cross-sectional area of 0·0048 square inch or less, the nominal cross-sectional area of the earth continuity conductor is to be equal to those of the current-carrying conductors.

(*c*) In flexible cords having conductors of a nominal cross-sectional area greater than 0·0048 square inch, and in flexible cables, the nominal cross-sectional area of the earth continuity conductors is to be at least 0·0048 square inch and, in general, not less than one-half those of the current-carrying conductors.

THE INSTALLING AND FIXING OF CABLES.

Section 9. **1. Cable Ends and Sockets.**—(*a*) Where substantial mechanical clamps are not used, the ends of every conductor having a nominal cross-sectional area exceeding 0·01 square inch (7/·044 in.) are to be provided with soldering sockets of such a size as to contain all the strands of the conductor.

(*b*) Soldering fluids containing acid or other corrosive substances are not to be used.

2. Preparation of Cable Ends.—(*a*) When soldering or securing the ends of conductors to sockets or terminals, the insulation is not to be removed further than is necessary to allow the unreduced conductor to enter and completely fill the socket or terminal.

(*b*) The braid, lead, or other covering over the insulation, including the tape in contact therewith, is to be cut back at least half an inch from the end of the insulation in cables up to ½ inch diameter (measured over the insulation), and at least one inch from the end of the insulation in cables of greater diameter.

3. Sealing of Cable Ends.—(*a*) The exposed conductor and insulation of impregnated-paper-insulated cables and varnished-cambric-insulated cables is to be protected from moisture by being suitably sealed.

(*b*) All the strands at the exposed ends of the conductors of impregnated-paper-insulated cables and varnished-cambric-insulated cables exceeding 0·0045 square inch sectional area are to be soldered together, where such exposed ends are not provided with cable sockets. The ends of the conductors of vulcanized-rubber-insulated cables in damp situations shall be similarly treated.

(*c*) Where vulcanized-rubber-insulated cables operate under exceptional conditions of heat or moisture, or are subject to other deleterious agents, their exposed ends are to be effectually sealed.

NOTE.—Under all conditions the life of vulcanized-rubber-insulated cables is considerably increased if means are taken to exclude air from exposed rubber insulation and from the conductor where it emerges from the rubber insulation.

4. **Selection of Cable Runs.**—(*a*) Cables are, as far as is practicable, to be fixed in accessible positions, so chosen that the cables are not exposed to drip or accumulation of water or oil, steam or oily vapour, high temperatures from boilers, steam pipes, exhaust pipes, radiators, resistors, or other hot objects, or to avoidable risk of mechanical damage. Unless adequately protected, cables are not to be laid under machines or floor-plates. Cables in winch contactor houses are, as far as is practicable, to be kept clear of the outer steel plating (if any) and away from the heat of the resistors.

(*b*) Cables, other than those specially designed for high temperatures, are not to be installed in any situation in which temperatures greater than the following are likely to be attained:

Type of Insulation.	Maximum Temperature of Cable Surroundings.
Vulcanized Rubber ...	115° F. (46° C.)
Impregnated Paper ...	150° F. (65·5° C.)
Varnished Cambric ...	150° F. (65·5° C.)

(*c*) A vulcanized-rubber-insulated cable is not to be so bent that the radius of the inside of the bend is less than that given in the following schedule.

Unarmoured.		Armoured.
Less than 1 inch overall diameter.	More than 1 inch overall diameter.	
4 times overall diameter of cable.	6 times overall diameter of cable.	6 times overall diameter of cable.

This requirement does not necessarily apply to bends in small cables where entering fittings, terminal boxes, etc.

(*d*) A cable (whether armoured or not) insulated with impregnated paper or varnished cambric is not to be so bent that the radius of the inside of the bend is less than eight times the overall diameter of the cable.

5. **Support and Protection.**—(*a*) All cables (other than flexible cables connected to portable or movable fittings) are to be securely fixed in position in accordance with the requirements of clauses 6, 7, and 8, below.

(*b*) Where exposed to risk of mechanical damage, cables shall be protected by sheet-iron plating or by heavy-gauge screwed steel conduit. The use of copper conduit is permitted. Copper conduit is not to be used in situations where it will be exposed to mechanical damage unless further protected by sheet-iron plating or other similar shielding.

(*c*) In machinery spaces, galleys, bathrooms, and laundries, or where unavoidably exposed to the weather or to the action of sea water, cables, other than vulcanized-rubber-sheathed cables of the "H.R." type, are either to be lead-alloy-sheathed, with or without further protection, or be run in conduit.

(*d*) Cables entering cold-storage chambers are to pass directly through the walls or lagging of the chamber and are to be protected by a continuous tube flanged at each end; alternatively, they may pass through holes in wood in door frames, in which case the holes are to be sealed at both ends.

(*e*) Cables fixed within cold-storage chambers are to be either lead-alloy-sheathed with or without armouring or braiding, or vulcanized-rubber-sheathed of the "H.R." type. They are not to be embedded in the walls or lagging, but are to be in full view throughout their length. They are to be supported on cleats made of porcelain, hardwood, or other non-metallic and non-hygroscopic material, provided that armoured cables may, if desired, be fixed with galvanized iron clips. As an alternative, cables may be carried on galvanized perforated plating which is so fixed as to leave a space between the back of the plating and the face of the chamber.

(*f*) Every lead-alloy-sheathed cable, whether armoured or not, is to have its lead-alloy sheath and armouring (if any) effectually earthed at both ends, provided that in final sub-circuits earthing may, if desired, be at the supply end only. Effectual means are to be taken to ensure that all metallic envelopes of cables are made electrically continuous throughout their length. All earthing connections are to be effected by means of clamps or soldered joints, or, alternatively, by glands specially designed for the purpose of forming part of joint boxes or similar fittings in which cables terminate.

(*g*) Metal staples are not to be used for fixing any cable.

(*h*) Flexible cords are not to be used for fixed wiring.

(*i*) Cables of opposite polarity may, if desired, be bunched in conduit if carrying direct current, but cables carrying alternating current are always to be so bunched that the outgoing and return cables are drawn into the same conduit.

(*j*) Cables carrying alternating current are to be kept separate from cables carrying direct current, and if on the same tray they are to be supported on separate cleats.

(*k*) Cables shall not be led through or be in direct contact with oil fuel tanks.

(*l*) Excessively large groups of cables are to be avoided.

NOTE.—Attention is drawn to the possibility of corrosion of the lead-alloy sheathings of cables as a result of contact, in the presence of moisture, with oak and other woods.

6. **Exposed or Cleated Wiring.**—(*a*) Lead-alloy-sheathed cables, whether armoured or not, and vulcanized-rubber-sheathed cables of the "H.R." type may, except as required by **clause 5** (*b*) above, be used without the further protection of casing, duct, or conduit, provided that they are secured by metal clips having smooth or rounded edges. All clips are to be firmly secured by screws of ample strength and are to be spaced in accordance with **Table XI**. The clips are to be formed of non-rusting material or shall have a non-rusting finish.

(*b*) Cables of all classes having a nominal cross-sectional area of 0·1 square inch and above may, if desired, be supported on cleats, which are to be spaced in accordance with **Table XI** and constructed of porcelain, hardwood, or other non-metallic, non-hygroscopic insulating material. The insulators are to have smooth or rounded edges that will not indent or damage the cable. In damp situations the supports and fixings of the insulators are to be of non-rusting material.

7. **Cables in Conduit.**—Any type of cable (other than the high-voltage cables specified in **Section 17** for luminous-discharge-tube installations) which complies with **Section 7, clause 1** may be enclosed in conduits, provided that:—

(*a*) The conduits and conduit fittings comply with the requirements of **clauses 9** and **10**.

(*b*) Ventilating outlets suitably placed are provided, preferably at the highest and lowest points of the conduits, to allow circulation of air and to ensure that water cannot lodge in any part of the conduits.

(*c*) The radius of any circuit is such as to permit of compliance with the requirements of **Section 9, clause 4** (*c*) and (*d*) for the bending of cables. In any event the inner radius of the bend is not to be less than $2\frac{1}{2}$ times the outside diameter of the conduit; and elbows or tees, other than those of the inspection type, are not to be used except at the end of conduits immediately behind accessories or lighting fittings.

(*d*) The ends of, and the outlets from, all conduits are bushed or so finished as to prevent abrasion of the coverings of cables emerging therefrom.

(*e*) The saddles and fixings used for securing the conduits are of non-rusting material or have a non-rusting finish.

(*f*) The conduits are earthed and are mechanically and electrically continuous across all joints.

(*g*) Communication cables are not fitted in the same conduit as cables supplying lighting and power, unless the lighting and power cables and/or the communication cables are protected by lead alloy sheathing or vulcanized rubber sheathing of the "H.R." type.

(*h*) The number of cables in one conduit is such that they can be easily drawn in, and, in any event, is such that the sum of the overall cross-sectional areas of the cables does not exceed for the respective types the following percentages of the internal cross-sectional area of the conduit:—

Braided cables	50 per cent.
Plain lead-alloy-sheathed cables	40 per cent.
Lead-alloy-sheathed cables armoured, with or without braiding over the armour ...	30 per cent.

In every run of conduit facilities are to be provided as may be necessary to obviate the drawing of cables around more than one bend of 90 degrees or two diversions of 45 degrees in the run of the conduit.

(*i*) Armoured cables and cables having fine wire braiding are not to be drawn into the same conduit as cables not similarly protected.

8. **Cables in Wood Casing.**—Any type of cable which complies with **Section 7, clause 1** may be enclosed in wood casing, provided that:—

(*a*) The casing is used only in dry situations and is not exposed to drip due to condensation or other cause.

(*b*) The casing and capping are secured by screws, which for the capping shall be of brass and on the outer edges only.

(*c*) Where the casing forms part of ornamental woodwork, the cables are readily accessible.

(*d*) Direct-current power, heating, and lighting cables of opposite polarity are not to be bunched in the same groove.

(*e*) Precautions are taken to ensure that, where cables from different grooves cross one another, they are separated by insulating material.

(*f*) Communication cables connected to systems having a voltage not exceeding 55 volts are not fitted in the same groove as cables connected to a system having a higher voltage.

(*g*) Armoured cables and cables having fine wire braiding are not to be fitted in the same groove as cables not similarly protected.

9. **Conduits.**—(*a*) Conduits, if of steel, and conduit fittings for use therewith, are, with the exception of inspection and draw boxes, to be of heavy gauge and welded or solid drawn.

(*b*) Conduits, if of copper, and clips and saddles for use therewith, may be used, subject to the requirements of clause 5 (*b*) above, provided full particulars are submitted and found satisfactory.

10. **Inspection and Draw Boxes.**—Inspection and draw boxes are to be of metal and shall be in rigid electrical and mechanical connection with the conduits. For steel conduits this connection is to be obtained by screwing into the box or into a device clamping both sides of the wall of the box. For copper conduits this connection is to be obtained by brazing or soldering a suitable ferrule to the conduit, the ferrule being secured to the box by screwing or by clamping to the wall of the box.

11. **Joints During Erection.**— (*a*) Connections between large vulcanized-rubber-insulated cables are to be made by means of clamped sleeves or tees in joint boxes constructed in accordance with Section 3, clause 22; and those between small cables and between small cables and flexible cables by means of clamped connections contained within suitable receptacles, which in the case of lamp fittings may, if desired, form part of such fittings. Joints in flexible cords are not permissible.

(*b*) Connections between impregnated-paper-insulated cables or between varnished-cambric-insulated cables may, if desired, be made by the same means as for vulcanized-rubber-insulated cables, provided the insulation at their ends is suitably sealed against moisture; or the conductors may be joined by means of copper sleeves, the whole being sweated together. Joints made in this manner are to be lapped with paper or pure cotton tape, impregnated immediately before use, and are to be enclosed in boxes or preferably in lead sleeves or tees wiped on to the cable sheaths, these receptacles being filled with an insulating compound impervious to moisture. Lead sleeves and tees are to be painted with two coats of tough elastic enamel on completion of the joint.

12. **Watertight Glands and Deck Tubes.**—All cables passing through decks or watertight bulkheads are to be provided with deck tubes or watertight glands.

13. **Cables Passing Through Bulkheads, etc.**—Unarmoured cables passing through beams, non-watertight bulkheads, etc., are to have the holes through which they pass bushed with lead or other soft non-ferrous metal, or suitable insulating material.

14. **Circuits of Voltages Exceeding 250 Volts.**—Where a voltage exceeding 250 volts is employed the wiring is to be completely enclosed in strong metal casing or heavy-gauge screwed conduit, or armouring which is electrically continuous, or, alternatively, the cables and other conductors are to be so constructed, installed, and protected, as to prevent danger so far as is reasonably practicable.

15. **Cables in Lift Shafts.**—In lift shafts and hoist shafts all cables, other than trailing cables, are to be armoured or enclosed in steel or other hard-metal conduits. If conduits are used the control leads and motor leads are to be in separate conduits.

In shafts subject to severe condensation, such as engine room lift shafts, the cables (other than trailing cables) are preferably to be of the lead-alloy-sheathed or the "H.R." type, run on the surface of the shaft in such a position as to be clear of wire ropes, trailing cables, etc. Sheet-iron protection covers are to be fitted over cables where liable to sustain damage.

16. **Cables over Expansion Joints.**—Cables are not to be led across expansion joints in the structure unless this is unavoidable. Where cables must cross an expansion joint they shall be arranged with a loop suitably supported having a diameter not less than 12 times that of the largest cable, to ensure the necessary flexibility.

ACCESSORIES AND LIGHTING FITTINGS.

Section 10. 1.—(*a*) Accessories and lighting fittings are to be so designed and constructed that the passages for the insulated conductors are of ample size and are free from rough projections, sharp angles, and abrupt bends. All outlets for cables shall have well-rounded edges or be bushed.

(*b*) Accessories and lighting fittings are to be so designed, and the insulated conductors so installed, that stress cannot be applied by the conductors to any terminal to which the conductors may be connected.

(*c*) Accessories and lighting fittings are to be so designed and fixed that dust and moisture cannot readily accumulate on the insulation or live parts.

(*d*) On weather decks, and wherever exposed to spray, drip or condensed moisture, accessories are to be of the watertight type.

(*e*) Watertight accessories are to be so constructed as to withstand, without the entry of water, immersion under a 3-feet head of water before fixing. After erection they are to be capable of withstanding, without the entry of water, the application of a stream of water ejected without restriction from an ordinary wash-deck hose under a head of 15 feet of water for a period of a quarter of a minute, the outlet of the hose being 6 feet away from the accessory or lighting fitting.

(*f*) The lanterns of navigation lights are to be watertight, and provided with suitable means for drawing off condensed moisture.

(*g*) Open-type lighting fittings, whether fixed or portable, are not to be used near readily combustible materials, or in spaces where inflammable or explosive dust or gases are likely to be present or where inflammable goods are stored.

(*h*) In spaces where explosive or inflammable dust or gases are likely to be present, accessories and lighting fittings are to be of the flame-proof type.

(*i*) Open-type lighting fittings are not to be furnished with combustible shades unless such shades are kept free from contact with the lamps by suitable guards or supports. Shades and candle tubes composed wholly or partly of nitrated celluloid are not to be used in any situation near a lamp.

(*j*) Switches and other accessories likely to cause an arc when they are operated are not to be installed in bunkers or other spaces in which inflammable or explosive dust, vapour, or gas, is likely to be present, irrespective of whether such switches or other accessories control lights in such spaces.

(*k*) The exposed metal parts of weatherproof, watertight, and flame-proof lighting fittings and accessories are to be earthed.

2. **Lighting Fittings.**—(*a*) Weatherproof lighting fittings are to have metal frames, and are to be so designed that the lamp is completely enclosed within a readily removable glass receptacle. The cable entries to the fittings are to be watertight, and the cable ends shall be so sealed as to prevent access of moisture to the conductor.

(*b*) Portable lighting fittings for the illumination of decks, holds, engine rooms, and similar spaces, are to be of the open type with frames of metal or other suitable material, or, alternatively, they are to be of the weatherproof type. Switches are not to be fixed on portable lighting fittings.

(*c*) On alternating-current systems of any voltage, and on direct-current systems the voltage of which exceeds 150 volts to earth, all metal parts (other than current-carrying parts) of portable lighting fittings are to be earthed through an earth continuity conductor in the flexible cord supplying the appliance, and such earth continuity conductor is to be in effectual electrical connection at one end with the metal frame (if any) of the fitting and at the other end with the earthed metal of the plug connection.

(*d*) The metal parts (other than current-carrying parts and lampholders) of open-type portable lighting fittings with metal frames are to be earthed as described in clause (*c*) above.

(*e*) Open-type portable lighting fittings with non-metallic frames, or of which the only non-current-carrying metal parts are guards surrounding the lamps, need not be earthed, provided the guards cannot come into metallic contact with the lampholders. Such lighting fittings are to be made of treated hardwood or suitable composite material capable of withstanding rough usage in service.

(*f*) In a portable lighting fitting a metal lampholder which is not in direct metallic contact with the frame of the fitting is to be separated from all metalwork of the fitting by insulating material, of adequate mechanical strength, which will not soften at 302° F. (150° C.), and is to be so shielded by means of similar insulating material that it cannot inadvertently be

touched by a person handling the fitting or replacing a lamp. For this purpose a glass bowl of a portable fitting is not to be regarded as an insulating shield for the lampholder.

(*g*) Every portable lighting fitting is to be provided with a hook or other suitable attachment to enable it to be hung up without damage to the flexible cord.

(*h*) Flexible cords for portable fittings are to conform to the requirements of Section 8. The protective covering, of whatever type employed, is to pass into the fitting or plug and be securely anchored thereto.

(*i*) Lighting fittings are to be so designed as to provide for adequate dissipation of heat from the lamps, and the insulated wires connected to the fittings are to be suitably protected from the effects of high temperature.

3. **Lampholders.**—(*a*) Lampholders, are, except as otherwise permitted in clause (*b*) below, to be of the following Standard types* :—

For lamps up to and including 150 watts	Standard bayonet (B.22) or Medium Edison screw (E.27)
For lamps above 150 watts and not exceeding 200 watts ...	Medium Edison screw) (E.27)
For lamps above 200 watts ...	Goliath Edison screw (E.40)

(*b*) Small lampholders may, if desired, be employed on systems not exceeding 130 volts, and miniature lampholders on systems not exceeding 24 volts.*

(*c*) Lampholders are to be constructed wholly of non-ignitable material, and all metal parts are to be of robust proportions. Goliath lampholders are to be provided with effective means for locking the lamp in the holder.

* The designations adopted by the International Electro-Technical Commission for lampholders and lamp-caps are as follows :—

Name of Cap.	Designation.
Screw Caps :—	
Goliath	E.40
Medium	E.27
Small	E.14
Miniature	E.10
Bayonet :—	
Normal	B.22
Small single contact	B.15s
Small double contact	B.15d

4. **Switches.**—Switches are to be constructed wholly of durable non-ignitable, non-hygroscopic materials.

5. **Ceiling Roses.**—Ceiling roses are to be constructed of non-ignitable, non-conducting, non-hygroscopic material.

6. **Socket Outlets and Plugs.**—(*a*) The live parts of socket-outlets and plugs are to be so proportioned that their average temperature does not exceed by more than 54° F. (30° C.) that of the surrounding air when the normal working current is flowing through them continuously.

(*b*) Socket-outlets and plugs are to be so constructed that they cannot be readily short-circuited whether the plug is in or out, and so that a pin of the plug cannot be made to earth either pole of the socket.

(*c*) The clearances of socket-outlets and plugs not interlocked with switches are to be such that an arc cannot be maintained if the plug be withdrawn from the socket while a current 50 per cent greater than that for which they are rated is flowing under a voltage 50 per cent in excess of the voltage of supply.

(*d*) All socket outlets and plugs having a current rating exceeding 5 amperes are to be provided with a switch so interlocked with the plug that the plug cannot be inserted or withdrawn with the switch in the "on" position.

(*e*) On weatherdecks, in stokeholds and engine rooms, and wherever exposed to drip or condensed moisture, socket-outlets and plugs are to be of the waterproof type.

(*f*) Weatherproof socket-outlets and plugs are to be of specially robust construction and be provided with efficient means to maintain the socket-outlet weatherproof when the plug is removed therefrom. Where a loose cover is employed for this purpose, it is to be anchored to a socket-outlet by means of a chain. When the plug is inserted in its socket-outlet the combined fitting and interlocking switch, if any, is also to be weatherproof.

(*g*) Socket-outlets are not to be fitted in bathrooms, lavatories, and similar places.

LAMPS.

Section 11. 1.—Arc Lamps other than Searchlight Lamps.—(*a*) Arc lamps are to have the whole of their live parts insulated from the frame or case.

(*b*) Every arc lamp is to be provided with a globe or lantern arranged to intercept falling particles of carbon, and with wire netting of not greater than 3-inch mesh so arranged as to prevent large pieces of broken glass falling therefrom.

(*c*) Arc lamps are to be so supported that they cannot swing into contact with any metallic object.

(*d*) Every arc lamp circuit is to be controlled by a fuse and switch on each insulated pole. Where more than one pole is insulated the switches are to be linked.

(*e*) Arc lamps are not to be installed or used in positions where inflammable goods are stored, or where inflammable or explosive dust, vapour, or gas, is likely to be present under normal conditions.

2. **Searchlight Lamps.**—(*a*) Searchlight lamps are to have the whole of their live parts insulated from the frame or case.

(*b*) All parts of a searchlight lamp which have to be handled for its operation or adjustment while in use are to be insulated from the circuit with strong, non-ignitable material, of substantial proportions, and be so disposed that there is no risk of shock to the operator.

(*c*) Where a circuit supplies a searchlight of arc lamp type it is to be controlled by a fuse and switch on each insulated pole. Where more than one pole is insulated the switches are to be linked. If a series resistance is used with the searchlight lamp, the controlling switch is to be in the supply leads to the resistance and not between the resistance and the searchlight lamp.

(*d*) The frame of every searchlight connected to a supply system having a voltage of 50 volts or above is to be provided with a suitable terminal to which the earth continuity conductor is to be connected.

3. **Lamps for Navigation Lights.**—All lamps for navigation lights are to be of the Board of Trade standard pattern and are not to be less than 32 candle-power, irrespective of whether they are of the carbon-filament or metal-filament type.

4. Electric Discharge Lamps.—(*a*) Where electric discharge lamps or luminous discharge tubes are used, lighting by one or more incandescent filament lamps is to be provided as necessary to ensure safety in the event of the extinction of the discharge lamps.

(*b*) Electric discharge lamps are to be so arranged as to operate satisfactorily with the ship inclined from the normal at any angle up to 15 degrees transversely and 10 degrees longitudinally, and with rolling up to 22½ degrees from the vertical.

ELECTRIC MOTORS.

Section 12. 1. **Rating of Motors.**—Motors are to conform to Appendix No. 3, except that for all ocean-going ships and ships operating in tropical waters the temperature rise, measured by thermometer at rated load, is not to exceed the limit shown in the following schedule :—

MOTORS NOT TOTALLY ENCLOSED.

	Temperature Rise.	
	Class A Insulation.	Class B Insulation.
Windings (other than single-layer field windings with exposed surfaces) and cores with which they are in contact	63° F. (35° C.)	81° F. (45° C.)
Single-layer field windings with exposed surface	81° F. (45° C.)	108° F. (60° C.)
Commutators ...	72° F. (40° C.)	72° F. (40° C.)

TOTALLY ENCLOSED MOTORS.

	Temperature Rise.	
	Class A Insulation.	Class B Insulation.
Windings (other than single-layer field windings with exposed surfaces) and cores with which they are in contact.	81° F. (45° C.)	108° F. (60° C.)
Single-layer field windings with exposed surface	81° F. (45° C.)	144° F. (80° C.)
Commutators ...	90° F. (50° C.)	90° F. (50° C.)

2. **Flameproof Motors.**—Are to conform to Appendices 3 and 6. The temperature rises at rated load are not to exceed 81° F. (45° C.) on the windings and 90° F. (50° C.) on the commutator, all temperatures being measured by thermometer.

3. **Excessive Ambient Temperature.**—Where the temperature of the cooling air exceeds 113° F. (45° C.) the permissible temperature rise of the motors is to be reduced by an amount equal to the excess temperature.

4. **Testing.**—Each motor engaged on essential services is to be tested at the maker's works, and a certificate giving the results is to be submitted for approval.

The tests are to include :—

(*a*) A temperature test at that rating which produces the greatest temperature rise. In cases where this cannot be predetermined, the machine is to be tested separately under each of its ratings.

(*b*) Speed-load characteristics.

(*c*) Speed range if variable speed.

(*d*) Insulation resistance.

(*e*) High voltage test.

Machines of 100 BHP and over are to be inspected by the Surveyors during manufacture and testing.

Where the fans for battery cooled chambers are electrically driven, the fan motors are to be inspected by the Surveyors during manufacture and testing irrespective of the horse-power rating of the motors.

5. **Construction of Motors.**—(*a*) Only Class A or Class B insulating materials, in accordance with Appendix No. 2, are to be used in the construction of motors.

(*b*) All motor windings are to be treated to resist moisture, sea air, and oil vapour.

(*c*) In motors for essential services, the following additional requirement is to be complied with :—

All motor windings are to be insulated from their frames and/or cores with mica or micanite, and in bar-wound armatures the insulation between conductors between upper and lower layers or equivalent portions, between which there is a periodic full rated voltage, is to be of micanite or other similar non-hygroscopic non-inflammable material.

(*d*) All working parts of motors are to be readily accessible, and all live parts in excess of 250 volts direct current to earth or 120 volts alternating current to earth are to be suitably guarded or enclosed (*see* Section 4, clause 7 (*a*)).

6. **Brushes.**—(*a*) Motor brushes for use on commutators or slip-rings are to be of carbon, graphite, or metal-graphite, and are to be provided with flexible copper connections.

(*b*) Commutator brushes are to be staggered longitudinally in such a manner that in multipolar motors every part of the commutator working surface is swept by the brushes, to prevent the formation of ridges. The staggering is to be so arranged that in multipolar direct-current motors a positive brush is always in line with a negative brush on an adjacent brush arm.

7. **Terminals.**—Suitable terminals, clearly marked, are to be provided in an accessible position, convenient for wiring, and where cable connections are used they are to be provided with cable sweating sockets. The terminals are to be effectually secured and are to be so spaced and/or shielded that they cannot be accidentally earthed, short-circuited, or touched.

8. **Mechanical Balance.**—Every motor is to be so constructed, erected, and supported, that when running at any and every working speed all revolving parts are well balanced, and the motor is not to give rise to any appreciable vibration on the test bed and in service.

9. **Lubrication.**—(*a*) Motors are to be efficiently and continuously lubricated automatically at all running speeds and all normal working oil temperatures when continuously inclined from the normal at any angle up to 15 degrees and when the ship is rolling up to 22½ degrees from the vertical without the spilling of oil, with the exception that the longitudinal angle may be limited to 10 degrees for motors placed with their axes of rotation in a fore-and-aft direction. Where ring lubrication is employed, the rings are to be so constrained that they cannot leave the shaft. Oil flingers or other suitable means are to be provided to prevent the lubricant creeping along the shaft or otherwise gaining access to the insulation of the machine or any live part thereof. Every oil-lubricated bearing is to be provided with a suitable overflow which, while permitting efficient lubrication when the machine is running, is to prevent the bearing from containing an excess of oil.

(*b*) Every self-lubricated sleeve bearing is to be fitted with an inspection lid and means for the visual indication of the oil level.

(*c*) Where forced lubrication is employed, an alternative means of lubrication such as oil rings or an oil reservoir is to be provided if no warning device is fitted, or a period exceeding 30 seconds elapses before the machine comes to rest after the interruption of power.

10. **Earthing.**—The bedplate (if any) and frame of every motor is to be effectually earthed.

11. **Shaft Currents.**—Means are to be taken to prevent the formation of circulating currents which might flow between the shafts and the bearings.

12. **Position in Ship.**—(*a*) Motors are, wherever possible, to be placed in well-ventilated compartments in which inflammable gases cannot accumulate, and in all cases are to be fixed clear of all inflammable material. Where these conditions cannot be complied with, motors fitted in such compartments are to be of the flame-proof type or forced-draught type with supply and exhaust pipes or ducts taken outside the compartment.

(*b*) Motors are, as far as possible, to be placed in positions in which they are not exposed to risk of mechanical injury or to damage from water, steam, or oil. Motors necessarily exposed to such conditions are to be one of the following types :—

(i) Totally enclosed.
(ii) Pipe-ventilated.
(iii) Drip-proof.
(iv) Watertight.
(v) Immersible.

(*c*) Pipe-ventilated motors are to be supplied with air as cool as possible, and the air intakes are to be guarded against the admission of dirt and/or moisture.

(*d*) Motors essential to the safety of the ship in the event of damage (e.g., emergency bilge-pump motors) are to be so installed as to be capable of running for a reasonable period after the compartment in which they are situated has been flooded.

13. **Axes of Rotation.**—Motors, other than those of the vertical-spindle type, are wherever possible, to be placed with their axes of rotation in a fore-and-aft direction. The end play is to be reduced to a minimum, and adequate provision is to be made for taking the end thrust due to the motion of the ship.

14. **Unprotected Woodwork, etc.**—No unprotected woodwork or unprotected, readily combustible material is to be within a distance of 12 inches measured horizontally from, or within 4 feet measured vertically above, any motor, unless the latter is enclosed.

MACHINE CONTROL GEAR.

Section 13. 1. **General Construction.**—(*a*) Field rheostats, speed regulators, motor starters, and motor controllers, are to be constructed wholly of durable, non-ignitable, non-hygroscopic materials, and unless otherwise guarded from approach, and where used for switchboards, are to be enclosed in non-ignitable cases.

(*b*) Machine control gear is to be unaffected by vibration or shock, and is to operate satisfactorily under all conditions with the ship inclined from the normal at any angle up to 15 degrees transversely and 10 degrees longitudinally, and with rolling up to $22\frac{1}{2}$ degrees from the vertical.

(*c*) The contact-making faces of machine control gear are to be sufficiently numerous to prevent destructive arcing, and the contacts and fingers of motor controllers and contactors are to be capable of withstanding at least 5,000 operations under full-load conditions without undue wear. At full-load current and full voltage, the interruption of the arcs is to be effected without the projection of molten metal and without destructive arcing. The wearing parts are to be easy to replace without completely dismantling the apparatus.

(*d*) Handles and their attachments of machine control gear are to be mechanically strong, and are to be so designed and arranged that the hand of the operator, when using the device, cannot touch live metal, or be injured through an arc arising from the device.

(*e*) Operating handles of machine control gear are not to, under working conditions, have a temperature rise of more than 27° F. (15° C.) above the ambient air temperature.

(*f*) The cases of machine control gear are to be effectually earthed.

(*g*) The clearances and creeping distances are to be suitable to the nature of the insulation provided, the provision made for arc quenching and the operating characteristics of the apparatus. The following figures are to be regarded as minimum

values applying to non-arcing parts in favourable circumstances in air and in oil, to earth or between poles or phases.

	Up to 250 V.		Above 250 V. and up to 440 V.		Above 440 V. and up to 650 V.	
	Clearance.	Creepage.	Clearance.	Creepage.	Clearance.	Creepage.
	inches.	inches.	inches.	inches.	inches.	inches.
Up to 10 amperes	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{3}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{1}{2}$
Over 10, up to 75 amperes	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{2}$
Over 75 amperes	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{5}{8}$

The clearance between arcing contacts and the case is to be such that operation within the rating of the apparatus can be carried out satisfactorily.

(*h*) Where a single master-starter system (i.e., a starter used for controlling a number of motors successively) is used, the apparatus is to provide under-voltage and over-current protection, and, for each motor, means of isolation not less effective than that required for systems employing a separate starter for each motor. Where the starter is of the automatic type, suitable alternative means is to be provided for manual operation. Where the starter is employed for the starting of motors for essential services, the starting portion is to be duplicated and means are to be provided for transfer in the event of failure of one of the starters.

(*i*) Where conduit is used for the external connections to machine control gear, the conduit is to be securely attached to the case and is to be so arranged as to enclose the cable completely at the point of entry into the case. Where lead-alloy-sheathed and/or armoured cable is used, provision is to be made to ensure that the metallic sheathing of the cable is so attached to the case of the apparatus as to ensure adequate electrical continuity.

2. **Temperature Limits.**— (*a*) The temperature limits specified in clauses (*c*) and (*d*) below are not to be exceeded. Where the ambient air temperature exceeds 104° F. (40° C.), the specified temperature rise is to be correspondingly reduced so that the specified total temperature is not exceeded.

(*b*) Continuously rated contacts and conductors are to be capable of sustaining the rated full-load current continuously and a 25 per cent overload for two hours after having reached a steady temperature corresponding to full load, without injury to themselves and without causing damage to any adjacent parts.

(*c*) The temperature limits of release, blow-out, contactor-operating, and relay coils which are left in circuit continuously at rated voltage and/or rated current, are not to exceed the values given in **Table XV**, temperature measurements being made by thermometer or by thermo-couple on the surface.

(*d*) The total temperature of metallic resistors is not to exceed 464° F. (240° C.) at any point [360° F. (200° C.) temperature rise] as measured by a thermometer placed in contact with the resistance material. The total temperature of the air issuing from a ventilated resistor is not to exceed 284° F. (140° C.), that is a temperature rise of 180° F. (100° C.) measured at a point 1 inch from the case. Where the temperature of any part of the case of a totally-enclosed resistor is likely to exceed 170° F. (76·6° C.), the apparatus is to be so located or guarded as to prevent it from being inadvertently touched.

3. Resistors.—(*a*) Internal connections of resistors are not to have soldered joints unless such joints are primarily secured mechanically. Bare connections of resistors are to be sufficiently rigid, or are to be (i) supported to prevent movement, *or* (ii) continuously insulated with porcelain beads, care being taken to prevent short-circuiting at crossings in the event of breakage or displacement of beads, *or* (iii) insulated with fire-proof non-hygroscopic material suitably supported to prevent contact with earthed metal or wires of opposite polarity.

(*b*) Where resistors are not self-supporting or rigidly fixed, they are to be supported throughout their length by non-ignitable, non-hygroscopic insulating material.

(*c*) Resistance elements, other than those of shunt field regulators, are to be readily replaceable.

4. **Range of Operation.**—Shunt operated contactors, releases and relays are to be capable of functioning satisfactorily even when the line voltage falls to 80 per cent for direct current and 85 per cent for alternating current at any permissible temperature within the working range.

5. Terminals.—(*a*) Suitable terminals with soldering sockets or mechanical clamps are to be provided for the attachment of external leads, and are to be so situated that such leads are not exposed at any point to a high temperature.

(*b*) Soldered sockets are not to be used on resistors unless a separate terminal board, not subject to high temperature, is provided.

6. Position in Ship.—(*a*) Machine control gear is, wherever practicable, to be placed in well-ventilated positions, free from the likelihood of an accumulation of inflammable vapour or gas. When such conditions cannot be complied with, such apparatus is to be flame-proof.

(*b*) Machine control gear is, wherever practicable, to be placed in positions in which it is not exposed to risk of mechanical injury or to damage from water, steam, or oil. Where necessarily exposed to such conditions it is to be totally enclosed. Glazed windows are to be as small as possible, consistent with their purpose, and are to be suitably protected.

(*c*) Resistors are to be placed in well-ventilated compartments, free from the likelihood of an accumulation of inflammable gases, and in such positions as to be clear of all inflammable material. No unprotected woodwork or unprotected, readily combustible material is to be within a distance of 6 inches measured horizontally from, or within 24 inches measured vertically above, the frames or cases of resistors.

7. Control of Motors.—(*a*) In addition to the fuses or circuit-breakers protecting the circuit, every motor above 1 brake horse-power is to be provided with a switch or circuit-breaker on each insulated pole. Where more than one pole is insulated, the switches are to be linked. The switch or circuit-breaker, when open, is to completely isolate the motor and its control gear. The isolating switch or circuit-breaker is preferably to be part of the control gear, provided that it is so shielded that live parts cannot be touched when the cover of the control gear is open, or it may be a separate unit fitted close thereto.

(*b*) Every direct-current motor above 1 brake horse-power, and every alternating-current motor above 5 brake horse-power, is to be provided with the following protecting and starting gear, in addition to the switch or circuit-breaker specified in clause (*a*) above:—

Either A starter or controller for inserting a variable resistance in series with the armature of the motor, or other means of limiting the current drawn from the system when the motor is starting and accelerating. The starter is to be provided with an under-voltage release and an over-current release.

Or A controller having combined switch and starting contacts so interlocked that they are to operate in proper sequence. The controller is to be provided with an under-voltage release and an over-current release.

8. Full-Load Currents of Motors.—For motor control gear, the maximum current of an electric motor is to be deemed to be the full-load rated current of the motor, and, unless the actual current be known, is to be taken to correspond to the values given in Table XIII for the types referred to therein. For motor outputs between those shown in the Table, the full-load current is to be taken to be directly proportional to the output and is to be calculated from the next lower output given in the Table.

9. Testing.—Control gear and resistances are to be tested by the makers with a high voltage applied between the earthed frame and all circuits between live parts forming positions of independent circuits. The test voltage is to be 1,000 volts plus twice the rated voltage, with a minimum of 2,000 volts alternating of any frequency between 25 and 100, maintained for one minute. Instruments forming part of the apparatus are to be included in this test unless the scale-length is $3\frac{1}{2}$ inches or less, in which case they are to be isolated and tested separately at 1,000 volts.

HEATING AND COOKING APPLIANCES.

Section 14. 1. General Construction.—(*a*) All electric heating and cooking appliances are to be so constructed and mounted that their supports and those parts which have necessarily to be handled in use cannot become heated to a temperature exceeding 130° F. (54° C.). The heating elements are to be of materials durable at the highest temperature which they attain, and are to be so arranged that they can be readily replaced.

(*b*) The electrical connections between the heating elements are to be effected either by joining parts of the elements themselves or by such construction that the connecting conductor will not deteriorate at the maximum temperature to which it may be subjected. The junction between the elements and switches or external connecting leads is to be effected without solder by suitable connections, which are to be so placed that the temperature of any part of the switches or terminals to which insulated cables may be connected cannot exceed 170° F. (76·6° C.).

(*c*) All connections between heating elements and between heating elements and terminals to which insulated cables may be connected are, unless self-supporting or rigidly fixed in position, to be continuously insulated with suitable non-inflammable material.

(*d*) All live parts, whether heating elements or terminals, are to be carried on non-hygroscopic non-inflammable insulating material.

(*e*) The heating elements of heating appliances are to be suitably guarded. The guards are to be of robust construction and so fitted that they cannot be brought into contact with any current-carrying part.

(*f*) All live parts of cooking appliances are to be so protected that the cooking utensils cannot be brought into contact with them.

2. **Provision for Earthing.**—All heating and cooking appliances, whether portable or fixed, are to be provided with suitable terminals for earthing the metal framework, and such terminals are to be effectively connected to earth.

3. **Control.**—Every heating and cooking appliance, whether portable or fixed, is to be controlled as a whole by a fixed switch, and where a socket-outlet is provided it is to be connected between the switch and the appliance.

4. **Portable Appliances.**—All portable heating and cooking appliances are to be of such shape or so weighted that they cannot easily be overturned, and suitable stowage positions are to be provided for them.

5. **Protection of Inflammable Materials.**—All inflammable materials in the vicinity of heating and cooking appliances are to be protected by suitable fire-resisting materials. Every heating appliance is to be so mounted that there will be at least one inch of air space between the appliance and the deck or bulkhead. Heaters are to be so designed and protected that clothing or other inflammable material cannot be placed over them in such a manner as to cause risk of fire.

6. **Air Heaters.**—(*a*) Heaters are to be such as to heat the surrounding air by convection, except that heaters of the radiation type may, if desired, be used provided they are designed and installed in such a manner as to minimize the risk of fire and full details are submitted in advance for approval.

(*b*) Heaters are to be durable and all parts are to be of strong construction. The protecting guards are to be strong enough to resist being forced against any current-carrying part. The openings are to be of small size to prevent the heating elements from being short-circuited or injured by accident.

7. **Explosion Risks.**—In situations in which an inflammable vapour or gas is likely to accumulate, heating appliances capable of igniting such vapour or gas are not to be installed.

SPECIAL REQUIREMENTS FOR SHIPS CARRYING OIL HAVING A FLASH POINT LESS THAN 150° F. (65·5° C.).

Section 15. 1. **General.**—Where flame-proof construction is specified in the following clauses 2 to 16, the apparatus is to comply with the requirements of flame-proof gear as specified in Appendix No. 6. Further, where clauses 2 to 16 require flame-proof apparatus to be used, and apparatus is obtainable which is covered by a certificate issued by a competent independent Testing Authority, such apparatus only is to be used.

2. **Nature of Supply.**—(*a*) Electrical supply for purposes other than main propulsion may be on the direct-current system or the alternating-current system, but in the latter case the arrangements are to be submitted for consideration.

(*b*) The voltage of supply is not to exceed 220 volts for power, heating and cooking, and 110 volts for lighting and cabin fans.

(*c*) Lighting circuits, cabin-fan circuits, and heating circuits, are not to have any electrical connection with a circuit (or source of supply) of higher voltage.

3. **Generating Plant.**—(*a*) Generating plant is to be fitted in the main engine room, or, alternatively, in a well ventilated machinery space separated from the cargo tanks by a cofferdam or equivalent safety space.

(*b*) Two or more generating sets are to be provided of such combined output that, in the event of one set being out of service, the remaining generating plant is to be capable of carrying the normal working load, except that in ships of less than 500 tons gross measurement where the supply is not employed for essential power services, one set only need be fitted, provided that a spare generator armature and set of field coils (including commutating-pole coils, where commutating poles are fitted) are carried.

4. Switchboards.—(*a*) The main switchboard is to be fitted in the same compartment as the generating plant.

(*b*) All switchboards, section boards, distribution fuse-boards, and joint boxes, are to be fitted well clear of boilers, steam or oil pipes, settling tanks, and Diesel-engine exhaust pipes or manifolds.

(*c*) Every outgoing circuit from the main switchboard and section boards is to be provided with a multi-pole (linked) circuit-breaker or, alternatively, a multi-pole (linked) switch arranged to interrupt the circuit on all poles simultaneously, with fuses of the type required in clause 9 (*e*) and (*f*) on each pole.

(*d*) Every earth-indicating device, other than one depending solely on lamps, is to be so designed that the flow of current to earth cannot exceed 30 milliamperes, and the inductance of the path to earth in the indicating circuit is not to exceed 60 millihenries. Where an earth-indicating system using two lamps is adopted, such lamps are to be of the metal-filament type, each not exceeding 15 watts. The system employing a single lamp is not to be used.

NOTE.—To facilitate comparison of the brilliance of earth indicating lamps they should be of the same colour and should be placed not more than 6 inches apart.

5. Distribution.—Distribution is to be effected wholly on the two-wire system with both poles insulated. No current-carrying part of the system, except as provided for in clause 4 (*d*), is to be earthed.

6. Cables.—(*a*) All cables, other than flexible cables and cables in accommodation, engine room, and boiler spaces (*see* clause (*b*)), are to have the protective sheathing specified in the following par. (i) or par. (ii):—

(i) Where run open, with or without additional protection from mechanical damage:—Cables sheathed with alloy (A), alloy (B) or alloy (E) specified in Section 7, clause 7, and bedded and armoured over the lead sheath, with or without cotton braiding over the armour.

(ii) Where protected from mechanical damage or run in pipes:—Cables sheathed with alloy (A), alloy (B) or alloy (E) specified in Section 7, clause 7, and either armoured or having as an outer protection fine steel wire braiding closely applied and suitably compounded.

(*b*) Cables (other than flexible cables) in accommodation, engine room, and boiler spaces are to be lead-alloy-sheathed, with or without braiding.

(*c*) The cables referred to in clause 7 (*b*) are to be insulated with varnished cambric, or with rubber of highest quality and specially suitable for withstanding extremes of temperature.

(*d*) Every flexible cable is to be provided with an earth continuity conductor in addition to the current-carrying conductors and, except for flexible cords in cabins and accommodation, the nominal cross-sectional area of every conductor in the cable is to be not less than 0·003 square inch. The earth continuity conductor in the flexible cable is to be effectively connected to the earth pin of the plug at one end and to the metal, if any, of the portable appliance at the other end. Every flexible cable is also to be provided with means for relieving the conductors of mechanical stress, and is to be so installed that such means are effective. Flexible cords in cabins and accommodation are to comply with the requirements of Section 8, paragraph 5.

(*e*) Every flexible cable is to have the cores so laid up and arranged as to provide the maximum degree of flexibility and freedom from internal damage due to twisting and kinking. For flexible cables having a nominal cross-sectional area greater than 0·007 square inch, an external close-fitting sheath tough rubber reinforced with embedded canvas is to be fitted, and it is to be of sufficient thickness and strength to protect the cores from external damage by heavy compression and abrasion.

7. Installation of Cables.—(*a*) Cables are to be so installed that they are not subjected to tension or chafing due to the working of the ship's structure.

(*b*) Cables installed on deck or under fore-and-aft gangways are to be run either in substantial channels of steel bar or plate, or, alternatively, in galvanized steel pipes fitted with bolted flanged joints or screwed unions. The thickness of the steel pipes is to be not less than that stated in the following schedule:—

Nominal Bore of Pipe. in.	Minimum S.W.G.	Thickness of Pipe. in.
¾	10	0·128
1	9	0·144
1¼	8	0·16
1½	7	0·176
2	7	0·176
2½ to 6	6	0·192

(*c*) Where channels or plating are employed the ends are not to be rigidly attached to bulkheads at the poop, midships house, and forecastle, and suitable expansion bends or bights are to be provided in the cables at these points.

(*d*) Where pipes are employed the total cross-sectional area of the cables contained within a single pipe is not to be more than 30 per cent of the internal cross-sectional area of the pipe. Substantial stuffing boxes with adjustable packed glands are to be provided at intervals in the run of pipes to allow for expansion and contraction, and the working of the ship. In particular, stuffing boxes are to be fitted at each bulkhead through which the pipes pass. The run of the pipes is to be as direct as possible to facilitate the drawing in of cables, and all parts of the pipe system are to be effectively drained and ventilated, and earthed in accordance with Section 9, clause 7 (*f*).

(*e*) All cables, and all pipes containing cables, running fore and aft are throughout their length to be kept at such a distance from steam and exhaust pipes as to be substantially free from any heating effect from such pipes. At the bulkheads this distance is to be not less than 18 inches from the flanges of steam pipes of more than 3 inch diameter, and not less than 12 inches from the flanges of steam pipes of 3 inch diameter or less.

(*f*) The total number of cables which run fore and aft is to be reduced to a minimum.

8. **Voltage Drop.**—In computing the sizes of main cables running forward from the engine room, special care is to be taken to avoid excessive voltage drop (*see* Section 6, clause 9), in view of the length of such conductors on this class of ship.

9. **Fittings and Accessories.**—(*a*) The enclosing cases of all section boards and distribution fuse-boards, are to be wholly of metal and, except in accommodation spaces, are to be watertight. Except in accommodation spaces, enclosing cases of lighting fittings and accessories are to be wholly of metal and are to be watertight or flame-proof as required under clause (*d*) below and clause 10. All metal cases are to be effectively earthed.

(*b*) All switches in distribution circuits are to be of the double-pole type arranged to interrupt the circuit on both poles simultaneously.

(*c*) Switches controlling the lighting fittings referred to in clauses 10 (*a*) and 15 (*a*) are to be fitted in safe positions, and are not to be immediately adjacent to the lighting points.

(*d*) Every socket outlet for use with flexible cables is to be of the three-pin type and is to be so interlocked that it is impossible to withdraw the plug when the switch is in the "on" position or to close the switch when the plug is withdrawn.

(*e*) Every fuse is to be of the indicating type, and the fuse-link is to be entirely enclosed in a non-ignitable non-hygroscopic insulating cartridge filled with refractory material. They are to comply with the requirements of Section 3, clause 20.

(*f*) It is to be impossible to fit a cartridge of higher rating in a given fuse without the use of special tools and parts.

(*g*) Switches and socket outlets other than those of the flameproof type are not to be fitted within 10 ft. of any oil tank outlet or vapour outlet.

10. **Lamps and Appliances.**—No lighting fitting, electrical appliance, or wiring of any kind, is to be installed in any oil tank, pump room, cofferdam, or any other space immediately adjacent to and below the top of the oil tanks. Every metal lighting fitting is to be effectively earthed and to have as a minimum the following enclosure corresponding to its position or use in the ship :—

(*a*) In between-deck spaces immediately above, or in exposed positions within a distance of 10 feet from, any oil tank outlet or vapour outlet—Flame-proof.

(*b*) Portable lamps fed by flexible cables—Watertight, and provided with strong metal guards.

(*c*) In engine rooms, store rooms, dry cargo holds, and similar safe spaces, also in exposed positions about the decks, other than those defined in clause (*a*) above—Watertight.

(*d*) Navigation and signal lights—Watertight.

11. **Lamps.**—(*a*) Luminous discharge tubes and electric discharge lamps are not to be used.

(*b*) Searchlights, other than those required to be fitted in compliance with the Suez Canal requirements for navigational purposes, are to be fitted with light sources of the metal filament type. The frames and all non-conducting metal parts are to be effectively earthed.

12. **Portable Appliances.**—The metal frame of every portable electric lamp, drill, and other appliance, fed through a flexible cable is to be provided with suitable means for permanent connection to the earth continuity conductor of the flexible cable, and is to be earthed.

13. **Heating and Cooking Appliances.**—Electrical cooking appliances (except where they are installed in the ship's galley aft of the oil tanks) and all electrical heaters are to be of the "black heat" type, and are to be securely fixed in position and permanently wired and metal frames are to be earthed.

14. **Cabin Fans.**—Cabin fans are to be permanently wired and fixed, and their frames are to be earthed.

15. **Cargo Pump Rooms.**—(*a*) Cargo pump rooms and similar machinery spaces are to be adequately lighted by lamps enclosed in flame-proof lighting fittings permanently wired and fitted wholly outside the space, always provided that pump rooms immediately adjacent to an engine room or similar safe space may be lighted through substantial gas-tight permanently fixed glazed ports, fitted in the bulkhead, and, where the lighting fitting is not immediately in contact with the bulkhead, the fitting used in such safe space need not be of flame-proof type.

(*b*) Portable lamps, other than self-contained battery-fed lamps of a type approved by a competent independent Testing Authority for use in explosive petroleum atmospheres, and gas detecting lamps similarly approved, are not to be used in any oil tank, pump room, cofferdam, or any other space immediately adjacent to and below the top of the oil tanks, unless the atmosphere therein has been tested and certified to be free from such explosive mixtures.

(*c*) There are to be secured in two or more conspicuous positions enamelled iron or similar permanent notices of ample size, prohibiting the use of lamps and other electrical appliances fed by flexible cables :—

(i) about the oil tanks, except with the permission of the Master.

(ii) in the oil tanks, cofferdams, or pump rooms, unless they have been certified to be free from explosive mixtures.

(*d*) Portable lamps and other portable electrical appliances are not to be used unless previously inspected to see that all parts are in position and that the earthing and other connections are in good order at the plug and the appliance.

16. **Motors.**—Motors and their starting or control gear are to be fitted only in the under-mentioned positions, and are to have as a minimum the enclosure corresponding to each position :—

(*a*) Machinery and steering gear spaces—Drip-proof type.

(*b*) Open deck, within 10 feet from an oil tank or vapour outlet—Flame-proof type; elsewhere on open deck—Watertight type.

(*c*) Radio and gyro-compass rooms where not liable to an accumulation of inflammable vapour—Protected type.

(*d*) Living accommodation (small cabin fans only)—Protected type.

SECONDARY BATTERIES.

Section 16. 1. General.—Secondary batteries installed permanently in position, except small batteries of portable types, are to comply with the requirements of clauses 2 to 8 below. The term "battery compartment" implies any compartment, recess or locker occupied by secondary batteries.

2. Construction.—The cells of secondary batteries are to be so constructed as to prevent spilling of the electrolyte due to the motion of the ship and prevent the emission of acid or alkaline spray on to surrounding objects. The containers are to be of strong construction and of non-brittle material; they are not to be of celluloid. The plates are to be of such dimensions and so arranged that they are firmly secured against motion within the containers.

3. Arrangement.—Every battery is to be so arranged that each cell or crate of cells is readily accessible from the top and from at least one side; the cells are, if possible, to be arranged in a single tier. The cells or crates are to be carried on insulators which are either to be integral with them or be separate components of glass, vitreous porcelain, ebonite, rubber, or equivalent material; and insulators of similar material are to be employed to prevent any movement of the cells arising from the motion of the ship.

4. Position of Battery Compartment.—The position of the battery compartment is to be such that no magnetic compass is affected by currents in the battery or in any conductors connected thereto.

5. Protection of Battery Compartment.—Where acid is used as the electrolyte for the battery, the deck below the cells is to be so protected with lead or other acid-resisting material as effectually to prevent any acid from lodging in contact with the structure of the ship. All metalwork within the battery compartment, including exposed metal on the battery and its connections, is to be protected with acid-resisting paint, unless such metalwork, by virtue of its composition or arrangement, or for other reasons, is not subject to the deleterious effects of acid.

6. **Ventilation of Battery Compartment.**—(*a*) The battery compartment is to be suitably ventilated so that it is impossible for battery gases to accumulate in appreciable quantities during periods of charging, discharging or standing on open circuit.

7. **Naked Lights.**—A permanent notice is to be exhibited prohibiting naked lights and smoking in the vicinity of the battery.

8. **Control.**—(*a*) Suitable means, including an ammeter and a voltmeter are to be provided for controlling the current with which a battery is to be charged and to protect against accidental discharge into the charging circuit.

(*b*) Switches, fuses and other electrical equipment liable to cause an arc are not to be placed within the battery compartment. The battery cables are to be protected by a fuse in each conductor at a position adjacent to the battery compartment.

ELECTRIC SIGNS AND LUMINOUS DISCHARGE TUBES.

Section 17. 1. **General.**—(*a*) External electric signs are not to be installed in a position where they are likely to obscure or be mistaken for any navigation light specified in the International Regulations for Preventing Collisions at Sea.

(*b*) The earthing of electric signs is to be carried out in compliance with Section 4, clause 6 (*a*). It is not necessary to earth metal clips or clamps used in positions remote from the terminals to support luminous-discharge-tubes, unless it is found desirable to effect the earthing of such clips or clamps in order to reduce interference with radio reception.

(*c*) Every motor and other mains-operated apparatus employed for switching or flashing of electric signs is to be connected to an independent final sub-circuit.

2. **Luminous-Discharge-Tube Installations.**—Every luminous-discharge-tube installation is, in addition to complying with such requirements of clauses 1 (*a*) to (*c*) above as are applicable, to comply with the following:—

(*a*) The voltage of primary circuits is not to exceed that permitted for ordinary lighting circuits.

(*b*) The secondary or high-voltage circuit is to be permanently earthed at the transformer, and the core of every transformer is to be earthed.

(*c*) Irrespective of the method of obtaining the voltage of the circuit which feeds the luminous-discharge-tubes, all parts of such circuit are to be isolated from the supply.

(*d*) Notices, made of durable material that will be unaffected by the weather and in size each not less than 18 square inches, are to be set up and maintained at points of access to the luminous-discharge-tubes, and where otherwise necessary. The notices are to bear the following wording.—

DANGER.
SWITCH TO BE LOCKED IN THE "OFF" POSITION BEFORE TOUCHING.

The word "DANGER" is to be in large red letters and the word "LOCKED" is to be emphasized. The remainder of the lettering is to be either black or white, depending on the colour of the plate.

3. **Luminous-Discharge-Tube Devices.**—In addition to the requirements of clause 2, fixed interior luminous-discharge-tube devices are to have all live metal parts enclosed in a suitable earthed case constructed of metal or lined with metal, such case being sealed and marked with the word "DANGER" on or near the seal.

4. **Submission of Plans.**—Full details of every luminous-discharge-tube installation, showing the position of all devices in connection therewith, the arrangement of circuits and locked switches and details of construction are to be submitted for approval.

INTERNAL COMMUNICATIONS.

Section 18. 1. **Construction of Transforming Plant.**—Motor-generators and static transformers used for the reduction of voltage for communication circuits are, together with their control gear, to comply with the clauses for similar plant employed for lighting and power supply.

2. **Batteries.**—Primary and secondary batteries are to be readily accessible at all times, and means are to be provided to prevent liquid from the cells coming into contact with the wooden floor or the structure of the ship. Secondary batteries are, in addition, to comply with such requirements of Section 16 as are applicable.

3. **Construction of Apparatus.**—(*a*) Where a communication system derives its supply from the lighting and/or power circuits, or where the voltage of supply exceeds 55 volts, all cables, wires, switches,

resistors, distribution fuse-boards, accessories, instruments, and other apparatus comprising such system, are to be designed, constructed and fitted throughout in all respects in accordance with such of the requirements for lighting and power circuits as are applicable.

(*b*) Where a communication system derives its supply from motor-generators, primary or secondary batteries, or static transformers, and is entirely electrically isolated from the lighting and power circuits, and the voltage of supply does not exceed 55 volts, the switches, resistors, distribution fuse-boards, accessories, instruments, and other apparatus in connection therewith, are to be of robust design and construction, and so installed as to ensure an ample margin of safety, having regard to the voltage employed.

(*c*) All materials and appliances, whether the conditions of service are as named in clauses 3 (*a*) or (*b*) above, are to conform with the remaining requirements of these Rules as far as applicable.

4. Cables.—(*a*) Cables used for the purpose of internal communication are to be of one or other of the types specified in Section 7, clause 1, and are to be fitted in a similar manner to cables installed for the lighting and power supply of the ship, and they are to be kept separate from the latter, unless the lighting and power cables and/or the communication cables are protected by lead-alloy sheathing or vulcanized rubber sheathing of the "H.R." type.

(*b*) Communication cables run in wood casing are not to be fixed in the same groove as the cables of lighting and power circuits.

5. Protection of Circuits.—Communication circuits, other than those supplied from primary batteries, are to be protected on each insulated pole by fuses of a current rating suited to the maximum current rating of the circuit to be protected.

6. Identification.—Communication circuits are to be so arranged and terminal boxes so designed, fitted, labelled, or otherwise marked to facilitate identification, as to enable fault-testing to be expeditiously carried out and the necessary repairs to be made with the minimum possible disturbance to other circuits.

7. Fire Alarm Circuits.—The circuits and apparatus of electric fire alarms are to comply with the requirements of clause 3 (*a*) above. Gongs are to emit a powerful and distinctive note.

LIGHTNING CONDUCTORS.

Section 19. 1. General.—Lightning conductors are to be fitted to each mast of all wooden, composite, and steel ships having wooden masts or topmasts. They need not be fitted to steel ships having steel masts.

2. Construction.—(*a*) In wooden and composite ships fitted with wooden masts, the lightning conductors are to be composed of continuous copper tape and/or rope, having a section not less than 0·15 square inch which are to be riveted with copper rivets or fastened with copper clamps to a suitable copper spike not less than 0·5 inches in diameter, projecting at least 6 inches above the top of the mast. Where tape is used the lower end of the tape is to terminate at the point at which the shrouds leave the mast, and is to be securely clamped to a copper rope of not less than 0·5 inch diameter. This copper rope is to be led down the shrouds and is to be securely clamped to a copper plate not less than 2 square feet in area, fixed well below the light-load waterline and attached to the ship's side in such a manner that it is to be immersed under all conditions of heel.

(*b*) In wooden and composite ships fitted with steel masts, each mast is to be connected to a copper plate in accordance with clause (*a*) above, the copper rope being securely attached to and in good electrical contact with the mast at or above the point at which the shrouds leave the mast.

(*c*) In steel ships fitted with wooden masts, the lightning conductors are to be composed of copper tape or rope terminating in a spike, as set forth in clause (*b*) above. At the lower end this copper tape or rope is to be securely clamped to the nearest metal forming part of the hull of the ship.

(*d*) Lightning conductors are to be run as straight as possible, and sharp bends in the conductors are to be avoided. All clamps used are to be of brass or copper preferably of the serrated contact type, and efficiently locked. No connection is to be dependent on a soldered joint.

(*e*) The resistance of the lightning conductor, measured between the mast head and the position on the earth plate or hull to which the lightning conductor is earthed, is not to exceed 0·02 ohms.

3. Protection when in Dry Dock.—It is recommended suitable means should be provided to enable ships when in a dry dock or on a slipway to have their

lightning conductors connected to an efficient earth on shore. All floating docks should be provided with appropriate means of earthing the lightning conductors of a vessel supported thereon.

SPECIAL REQUIREMENTS TO BE COMPLIED WITH WHERE THE CONSTANT-CURRENT SERIES SYSTEM IS USED FOR PURPOSES OTHER THAN PROPULSION.

Section 20. 1. **Working Voltage.**—The working voltage of any constant-current series system is not to exceed 650 volts.

2. **Generators and Motors.**—(*a*) Generators and motors are not to be of the open type.

(*b*) Every motor is to be so protected that its speed cannot exceed a predetermined safe limit.

3. **Switchgear.**—(*a*) An automatic device is to be provided with every generator to reduce its voltage to zero in the event of any open circuit occurring at any part in the system. This device is not to be applied to short circuit the generators.

(*b*) When more than one generator is fitted, each such machine is to be provided with a double-pole selector switch arranged to connect the generator in series with the system or alternatively to isolate the generator by :—

(i) Short circuiting the machine after reducing its voltage to zero.
(ii) Completing the continuity of the circuit.
(iii) Disconnecting the machine.

(*c*) All distribution switches are to be capable of effecting the same operations as the generator selector switches (*see* clause (*b*) above).

(*d*) Every current-consuming device is to be provided with a main switch, which is to isolate the device from the system without breaking the main circuit.

(*e*) Every motor is to be provided with a by-pass switch which is to automatically short circuit the motor terminals when its armature is at rest and the controller is at zero speed position.

4. **Earthing.**—No part of the system is to be earthed.

TRIALS.

Section 21. 1. **General.**—Before a new installation or alterations or additions to an existing installation are put into service, the appropriate trials specified in clauses 2 to 18 inclusive are to be made. Such trials are to be in addition to, and not in substitution for, the acceptance trials of the individual items of plant at the makers' works.

2. **Testing Voltage.**—The voltage used for the insulation-resistance tests referred to in clauses 3 to 7 inclusive is to be a direct-current voltage not less than twice that to which the circuits will normally be subject (twice the root-mean-square value if the supply is alternating-current), provided that it need not exceed 500 volts for circuits normally not exceeding 650 volts.

3. **Insulation Resistance of Completed Installation.**—Before a completed installation, or an addition to an existing installation, is put into service, the insulation resistance to earth of every distribution circuit is to be not less in megohms than 50 divided by the number of outlets (points and switches) from the fixed wiring, except that it need not exceed 1 megohm. The test is to be made with all fuse-links in place, all switches (except the supply switch) closed, and, except with systems having one pole of the supply permanently earthed, all lamps in position or both poles of the installation otherwise electrically connected together.

4. **Switchboards.**—Before a main switchboard, emergency switchboard, or section board, is put into service, the insulation resistance is to be not less than one megohm, when measured :—

(i) between each insulated busbar and earth.
(ii) between each insulated busbar and the busbar connected to the other pole or poles.

The test is to be made with all circuit-breakers and switches in the open position and all fuse-links for pilot lamps, earth lamps, voltmeters, etc., removed. Voltage coils normally connected to the busbars are to be temporarily disconnected while the test between poles is being made.

5. **Heating and Power Appliances.**—During the test of any circuit, control rheostats and heating and power appliances normally connected to the circuit may, if desired, be disconnected; but in that event the insulation resistance between the case and/or framework and all live parts of every rheostat and appliance is to be not less than half a megohm.

6. **Testing between Conductors.**—Where practicable, the insulation resistance is also to be measured between all the conductors connected to each pole of the supply and all the conductors connected to the other pole or poles or to the "middle wire" or the "neutral"; and its value is not to be less than that specified in clause 3.

7. **Testing Polarity of Fuses and Single-Pole Switches.**—Precautions are to be taken to verify that no fuse, non-linked switch, or non-linked circuit-breaker, has been connected to that pole of a circuit which is either earthed or derives its polarity from an earthed conductor.

8. **Testing Earth Continuity.**—(*a*) Where lead-alloy-sheathed cables or armoured cables are employed, tests are to be made where necessary to verify that all metallic envelopes are electrically continuous throughout their length, and are earthed as required by Section 9, clause 5 (*f*).

(*b*) Tests shall be made to verify that all earth continuity conductors and earthing leads are connected to the frames of the fittings and appliances, and to the hull of the ship, and that in socket-outlets having earthing contact-tubes, the latter are also connected to the hull.

9. **Insulation Resistance of Generators and Motors.**—(*a*) The insulation resistance in megohms of every completed generator and motor in normal working condition and with all parts in place is not to be less than

$$\frac{3 \times \text{Rated Voltage of Machine}}{1{,}000 + \text{Rated Output of Machine in kVA}}$$

All insulation tests are, where possible, to be made when the generators and motors are hot.

(*b*) The insulation resistance of generator cables, motor cables, field windings, and control gear, when isolated and separated for testing purposes, is not to be less than 1 megohm.

10. **Generating Sets, Switchgear and Connections.**—It is to be demonstrated that the relevant requirements of these Regulations have been complied with in respect of the following :—

(*a*) The satisfactory commutation and performance of every generator throughout a run at full rated load.

(*b*) The temperatures of all joints and connections, fuses, circuit-breakers, and busbars.

(*c*) The operation of engine speed governors, over-speed trips, generator reverse-current and over-current trips, and other safety devices.

(*d*) The voltage regulation of every generator, when full rated load is suddenly thrown off by operating the circuit-breaker or main switch (*see* Section 2, clauses 5 (*b*) and 5 (*d*)).

(*e*) The satisfactory operation in parallel, load sharing, etc., of all generators capable of being run in parallel with a load on the busbars of not less than 1½ times the full load rating of the largest generator.

11. **Motors and Generators.**—Every motor (with its control gear) is to be run under service conditions for a sufficient length of time to demonstrate that its wiring, alignment, size, direction of rotation, speed, commutation and temperature, are satisfactory.

12. **Apparatus.**—All lamps, heaters and other appliances are to be run, though not necessarily under full load or simultaneously. Tests of voltage are to be made, if necessary, to verify compliance with Section 6, clause 9 (voltage drop).

SPARE GEAR.

Section 22.—In vessels engaged in open sea service, the articles mentioned in the following list (so far as they are applicable) will be required to be carried, viz. :—

For the Generators.

For each size of generator :—

1 set of carbon brushes for one machine.
1 set of any special spanners required.

For the Motors.

For each size of motor engaged on essential services, such as those enumerated below :—

1 set of carbon brushes for one machine.
1 set of any special spanners required.

The following are motors for which spare gear is required :—

Auxiliary compressors.
Scavenge blowers.
Cooling water pumps for main engines.
Cargo refrigerating motors, including compressors, brine pumps, circulating pump, fans, etc.
Oil fuel pumps.
Fans for forced draught to boilers.
Condenser circulating pumps.
Air pumps.
Feed water pumps.
Fire pumps.
Bilge pumps.
Steering gear.
Windlasses.
Ventilating fans for engine room and boiler rooms.

For the Steering Gear.

For each size of steering gear motor and motor-generator, if no standby machine is installed, the following spare gear is required in addition to the spares for motors enumerated above.

1 spare armature of each size fitted, complete with shaft and half coupling.

1 spare field coil of each type fitted.

Where electric steering gear is fitted and there is no standby generator, similar spare gear is also to be provided for the generator.

For Fans for Refrigerating Equipment.

For electrically driven air circulating fans the following spare gear will be required:—

1 complete fan and motor of each size used.

For the Control Gear.

For the starting gear of motors, such as those enumerated above:—

1 set of contacts subject to burning or wear.

1 set of springs.

10 per cent of each different resistance element, but at least one of each.

1 of each type of coil used for contactors, relays or low voltage release.

For six or less starters in which these parts are interchangeable it will be sufficient to provide one set of spares for the starter employing the greatest number of parts.

For the Switchgear and Distribution Boards.

For each type of circuit-breaker on each pole:—

1 set of contacts which are liable to be burnt or worn.

1 set of parts subject to wear.

1 set of springs.

1 shunt trip coil and 1 resistance element, of each kind used.

10 per cent but not less than 12 of each type of cartridge or other non-rewireable fusible cut-out.

Rewireable fuse-handles; 5 per cent, with a minimum of one, of each size or type used, provided that not more than 12 need be supplied.

For the Navigating and Signal Lights, and their pilot lamps for indicating devices:—

1 complete spare set of lamps.

Emergency Lighting.

Where there is supplied from storage batteries of a voltage different from the ship's circuit:—

1 complete spare set of lamps.

Insulation Tester.

It is recommended that a 500 volt insulation tester be provided with all equipment of 100 kw. and above for the testing of insulation and tracing of faults and that all parts of the system be periodically tested and the results recorded.

PERIODICAL SURVEYS.

Section 23. The periodical surveys of electrical equipment are detailed on page 27.

71, Fenchurch Street, London, E.C.3.

17th October, 1946.

TABLE I.

CURRENT RATING FOR VULCANIZED-RUBBER-INSULATED CABLES.—SINGLE CABLES.

Conductor.		Ambient Temperature up to 100° F.				Ambient Temperature 101° F.–115° F.		
		Current Rating‡		Approximate Length in Circuit (*Lead plus Return*) for 1-volt Drop with Current Rating in Col. 3 or Col. 4.		Current Rating‡	Approximate Length in Circuit for 1-volt Drop with Current Rating in Col. 7.	
Nominal Cross-Sectional Area.	Number and Diameter (in.) of Wires	Direct Current.	Single-phase Alternating Current.	Direct Current.	Single-phase Alternating Current.	Direct Current, or Single-phase Alternating Current.	*Lead plus Return*, for Direct Current.	*Lead plus Return*, for Single-phase A.C.;
1.	2.	3.	4.	5.	6.	7.	8.	9.
sq. in.		amps.	amps.	feet.	feet.	amps.	feet.	feet.
0·0015	1/·044	5	5	36	36	3·5	52	52
0·002	3/·029	5	5	47	47	3·5	67	67
0·003	3/·036	10	10	35	35	7·0	50	50
0·003	1/·064	10	10	37	37	7·0	53	53
0·0045	7/·029	15	15	34	34	10·5	49	49
0·007	7/·036	24	24	33	33	17	47	47
0·01	7/·044	31	31	39	39	22	56	56
0·0145	7/·052	37	37	45	45	26	64	64
0·0225	7/·064	46	46	55	55	32	79	79
0·03	19/·044	53	53	61	60	37	87	87
0·04	19/·052	64	64	71	70	45	101	101
0·06	19/·064	83	83	83	80	58	119	119
0·1	19/·083	118	118	98	92	83	140	137
0·15	37/·072	152	152	112	97	106	160	147
0·2	37/·083	184	184	123	98	129	176	147
0·3	37/·103	240	240	145	97	168	207	139
0·4	61/·093	288	288	162	90	202	231	129
0·5	61/·103	332	332	172	82	233	246	117
0·75	91/·103	461	425	185	69	323	265	98
1·0	127/·103	595	520	200	59	416	286	85

‡ The current ratings in Table I are subject to the maximum permissible voltage drop (*See* Section 6, clause 9) not being exceeded.

LLOYD'S REGISTER OF SHIPPING, LONDON.—*17th October, 1946.*

TABLE II.

CURRENT RATINGS FOR CABLES INSULATED WITH IMPREGNATED PAPER OR VARNISHED CAMBRIC—SINGLE CABLES.

Conductor.		Ambient Temperature up to 120° F.				Ambient Temperature—121°-150° F.		
		Current Rating‡.		Approximate Length in Circuit (*Lead plus Return*) for 1-volt Drop with Current Rating in Col. 3 or Col. 4.		Current Rating‡.	Approximate Length in Circuit for 1-volt Drop with Current Rating in Col. 7.	
Nominal Cross-Sectional Area.	Number and Diameter (in.) of Wires.	Direct Current.	Single-phase Alternating Current.	Direct Current.	Single-phase Alternating Current.	Direct Current, or Single-phase Alternating Current.	*Lead plus Return*, for Direct Current.	*Lead plus Return*, for Single-phase A.C.
1.	2.	3.	4.	5.	6.	7.	8.	9.
sq.in.		amps.	amps.	feet.	feet.	amps.	feet.	feet.
0·007	7/·036	28	28	27	27	22	34	34
0·01	7/·044	42	42	27	27	34	34	34
0·0145	7/·052	57	57	28	28	46	35	35
0·0225	7/·064	75	75	32	32	60	40	40
0·03	19/·044	87	87	35	35	70	44	44
0·04	19/·052	104	104	41	41	83	51	51
0·06	19/·064	135	135	48	46	108	60	60
0·1	19/·083	191	191	57	53	153	71	70
0·15	37/·072	246	246	65	56	197	81	74
0·2	37/·083	296	296	72	57	237	90	75
0·3	37/·103	385	385	85	57	300	106	75
0·4	61/·093	464	464	95	53	371	119	70
0·5	61/·103	540	540	100	48	432	125	63
0·75	91/·103	738	670	109	41	590	136	51
1·0	127/·103	932	795	121	37	745	152	46

‡ The current ratings in Table II are subject to the maximum permissible voltage drop (*see* Section 6, clause 9) not being exceeded.

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TABLE III.

Maximum Permissible Current* in Intermittently-loaded Cables.

Conductor.		Vulcanized-Rubber-Insulated Cables.		Impregnated-Paper-Insulated Cables and Varnished-Cambric-Insulated Cables.	
Nominal Cross-Sectional Area.	Number and Diameter (in.) of Wires.	Current for Half-hour Rating.	Current for One-hour Rating.	Current for Half-hour Rating.	Current for One-hour Rating.
1.	2.	3.	4.	5.	6.
sq. in.		amps.	amps.	amps.	amps.
0·0145	7/·052	38	37	60	57
0·0225	7/·064	47	46	79	75
0·03	19/·044	56	54	94	89
0·04	19/·052	68	65	113	105
0·06	19/·064	92	85	151	138
0·1	19/·083	142	124	225	199
0·15	37/·072	191	164	303	261
0·2	37/·083	247	204	376	320
0·3	37/·103	351	283	523	435
0·4	61/·093	452	357	663	543
0·5	61/·103	534	422	804	648
0·75	91/·103	774	604	1,180	930
1·0	127/·103	1,036	803	1,548	1,211

* The values in Table III are subject to the maximum permissible voltage drop (*see* Section 6, clause 9) not being exceeded. The approximate length in circuit (*Lead plus Return*) for 1 volt drop will be the corresponding length given in Tables I and II respectively multiplied by the continuous rating in amperes and divided by the nterm ittent rating.

TABLE IV.

Current Rating and Radial Thickness of Dielectric for Twin Flexible Cords and Flexible Cables.

Conductor.		Current Rating*	Approximate Length in Circuit (*Lead plus Return*) for 1-volt Drop with Current Rating in Col. 3.	Radial Thickness of Dielectric.	
Nominal Cross-Sectional Area.	Number and Diameter (in.) of Wires.			250-volt Cables.	660-volt Cables.
1.	2.	3.	4.	5.	6.
sq. in.		amps.	feet.	in.	in.
0·0006	14/·0076	2	53	0·033	—
0·001	23/·0076	3	59	0·034	—
0·0017	40/·0076	5	57	0·035	—
0·003	70/·0076	10	50	0·036	—
0·0048	110/·0076	15	48	0·038	—
0·007	162/·0076	20	48	0·039	—
0·01	97/·012†	25	49	0·043	0·060
0·0145	60/·018†	30	58	0·046	0·061
0·0225	91/·018†	37	70	0·049	0·062

* The current ratings in Table IV are subject to the maximum permissible voltage drop not being exceeded.

† For trailing cables and similar purposes.

Lloyd's Register of Shipping, London.—*13th April, 1939.*

TABLE V.

Dimensions of 250 Volt Vulcanized-Rubber-Insulated Cables.

Conductors.		D. Minimum Thickness of Dielectric.	Minimum Thickness of Lead Alloy Sheath.			Diameter of Armouring Wire Single Core.*	Minimum Thickness of "H.R." Sheathing.		
Nominal Cross Sectional Area.	Number and Diameter (in.) of Wires.		Single Core.	Twin Core. Circular.	Three Core.† Circular.		Single Core.	Twin Core.	Three Core.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
sq. in.		in.	in.	in.	in.	in.	in.	in.	in.
0·0015	1/·044	0·034	0·04	0·04	0·05	—	0·040	—	—
0·002	3/·029	0·036	0·04	0·04	0·05	0·048	0·040	0·055	0·055
0·003	1/·064	0·036	0·04	0·04	0·05	0·048	0·040	0·055	0·055
0·003	3/·036	0·038	0·04	0·04	0·05	0·048	0·040	0·060	0·060
0·0045	7/·029	0·039	0·04	0·05	0·06	0·048	0·040	0·060	0·060
0·007	7/·036	0·041	0·05	0·05	0·06	0·048	0·050	0·065	0·065
0·010	7/·044	0·043	0·05	0·05	0·07	0·048	0·050	0·065	—
0·0145	7/·052	0·046	0·06	0·06	0·07	0·048	0·055	0·065	—
0·0225	7/·064	0·049	0·06	0·06	0·07	0·048	0·055	0·065	—
0·030	19/·044	0·052	0·06	0·07	0·08	0·048	0·055	—	—
0·040	19/·052	0·056	0·06	0·08	0·09	0·064	0·060	—	—
0·060	19/·064	0·062	0·07	0·08	0·09	0·064	0·065	—	—

* For determining the sizes of Armouring Wire for Twin-Core and Three-Core Cables see TABLE IX.

† The thickness of lead alloy sheath on Multicore Cables in which the Conductors are not of equal area is to be the same as that for a similar Cable having Conductors equal in area to that of the largest of the unequal Conductors.

D is the thickness of the dielectric as follows :—

(1) On the Conductor of Single-Core Cables.

(2) On each core of Twin and Three-Core Cables.

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TABLE VI.

DIMENSIONS OF 660 VOLT VULCANIZED-RUBBER-INSULATED CABLES.

Conductors.		D. Minimum Thickness of Dielectric.	Minimum Thickness of Lead Alloy Sheathing.			Diameter of Armouring Wire Single Core.*	Minimum Thickness of "H.R." Sheathing.		
Nominal Cross Sectional Area.	Number and Diameter (in.) of Wires.		Single Core.	Twin Core Circular.	Three Core† Circular.		Single Core.	Twin Core.	Three Core.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
sq. in.		in.	in.	in.	in.	in.	in.	in.	in.
0·0015	1/·044	0·055	0·05	0·05	0·06	0·048	0·040	—	—
0·002	3/·029	0·056	0·05	0·05	0·06	0·048	0·040	0·060	0·060
0·003	1/·064	0·057	0·05	0·05	0·06	0·048	0·040	0·060	0·065
0·003	3/·036	0·057	0·05	0·05	0·06	0·048	0·050	0·065	0·065
0·0045	7/·029	0·058	0·05	0·06	0·07	0·048	0·050	0·065	0·065
0·007	7/·036	0·059	0·06	0·06	0·07	0·048	0·050	0·065	0·065
0·01	7/·044	0·060	0·06	0·06	0·08	0·048	0·055	0·065	—
0·0145	7/·052	0·061	0·06	0·07	0·08	0·048	0·055	0·065	—
0·0225	7/·064	0·062	0·06	0·07	0·08	0·048	0·055	0·065	—
0·03	19/·044	0·062	0·06	0·07	0·08	0·048	0·060	—	—
0·04	19/·052	0·063	0·06	0·08	0·09	0·064	0·060	—	—
0·06	19/·064	0·065	0·07	0·08	0·09	0·064	0·065	—	—
0·1	19/·083	0·072	0·07	0·09	0·10	0·064	0·065	—	—
0·15	37/·072	0·080	0·08	0·09	0·10	0·080	0·065	—	—
0·2	37/·083	0·088	0·08	0·10	0·11	0·080	0·070	—	—
0·3	37/·103	0·102	0·09	0·12	0·13	0·104	0·070	—	—
0·4	61/·093	0·114	0·10	0·13	0·14	0·104	0·080	—	—
0·5	61/·103	0·121	0·11	0·14	0·15	0·104	0·085	—	—
0·75	91/·103	0·131	0·12	—	—	0·104	0·100	—	—
1·0	127/·103	0·141	0·12	—	—	0·104	0·110	—	—

* For determining the sizes of Armouring Wire for Twin-Core or Three-Core Cables see TABLE IX.

† The thickness of lead on Multicore Cables in which the Conductors are not of equal area is to be the same as that for a similar Cable having Conductors equal in area to that of the largest of the unequal Conductors.

D is the thickness of the dielectric as follows:—

(1) On the Conductor of single Conductor Cables.

(2) On each core of Twin and Three-Core Cables.

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TABLE VII.

DIMENSIONS OF 1,000 VOLT CABLES—PAPER INSULATED OR VARNISHED CAMBRIC INSULATED.

Conductor.		D. Minimum Thickness of Dielectric.	Minimum Thickness of Lead Alloy Sheathing.					Diameter of Armouring Wire Single Core.*
			Single Core.	Twin Core.		Three Core.		
Nominal Area.	Number and Diameter (in.) of Wires.			Circular Conductor.	Shaped Conductor.	Circular Conductor.	Shaped Conductor.	
1.	2.	3.	4	5.	6.	7.	8.	9.
sq. in.		in.	in.	in.	in.	in.	in.	in.
0·0015	1/·044	0·07	0·06	—	—	—	—	0·064
0·0020	3/·029	0·07	0·06	—	—	—	—	0·064
0·0030	1/·064	0·07	0·06	—	—	—	—	0·064
0·0030	3/·036	0·07	0·06	—	—	—	—	0·064
0·0045	7/·029	0·07	0·06	—	—	—	—	0·064
0·0070	7/·036	0·07	0·06	0·06	—	0·06	—	0·064
0·0100	7/·044	0·07	0·06	0·06	—	0·06	—	0·064
0·0145	7/·052	0·07	0·06	0·06	0·06	0·06	—	0·072
0·0225	7/·064	0·07	0·06	0·06	0·06	0·06	0·06	0·072
0·0300	19/·044	0·07	0·06	0·06	0·06	0·06	0·06	0·072
0·0400	19/·052	0·07	0·06	0·06	0·06	0·06	0·06	0·072
0·0600	19/·064	0·07	0·06	0·07	0·06	0·07	0·06	0·072
0·1000	19/·083	0·07	0·06	0·07	0·06	0·08	0·07	0·072
0·1500	37/·072	0·07	0·07	0·08	0·07	0·08	0·07	0·072
0·2000	37/·083	0·07	0·07	0·09	0·07	0·09	0·08	0·080
0·3000	37/·103	0·08	0·08	0·10	0·08	0·10	0·09	0·080
0·4000	61/·093	0·09	0·08	0·11	0·09	0·11	0·10	0·104
0·5000	61/·103	0·09	0·08	0·12	0·09	0·12	0·10	0·104
0·7500	91/·103	0·10	0·09	0·13	0·11	0·14	0·13	0·128
1·0000	127/·103	0·10	0·10	0·15	0·13	0·15	0·14	0·128

*For determining the sizes of Armouring Wire for Twin-Core or Three-Core Cables see TABLE IX.

D is the thickness of dielectric between any one Conductor and the next Conductor or the Lead Sheath.

The thickness of sheath on Multi-Core Cables in the case where the Conductors are *not of equal area* is to be the same as that for similar Cable having Conductors equal in area to that of the largest of the unequal Conductors.

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TABLE VIII.

3,300 VOLT PAPER INSULATED OR VARNISHED CAMBRIC INSULATED CABLES.
THICKNESS OF DIELECTRIC AND LEAD SHEATH.

Nominal Area of Conductor.	Minimum Thickness of Insulation.		Minimum Thickness of Lead Sheath.					
			Single Core.		Three Core.			
					Centre Point not Earthed.		Centre Point Earthed.	
	Centre Point not Earthed D (*See note below*).	Centre Point Earthed E (*See note below*).	Centre Point not Earthed.	Centre Point Earthed.	Circular Conductors.	Shaped Conductors.	Circular Conductors.	Shaped Conductors.
1.	2.	3.	4.	5.	6.	7.	8.	9.
			PAPER INSULATED.					
sq. in.	in.	in.	in.	in.	in.	in.	in.	in.
0·0225	0·11	0·09	0·06	0·06	0·06	0·06	0·06	0·06
0·03	0·11	0·09	0·06	0·06	0·06	0·06	0·06	0·06
0·04	0·11	0·09	0·06	0·06	0·07	0·06	0·07	0·06
0·06	0·11	0·09	0·06	0·06	0·07	0·07	0·07	0·06
0·075	0·11	0·09	0·06	0·06	0·08	0·07	0·07	0·07
0·1	0·11	0·09	0·07	0·06	0·08	0·07	0·08	0·07
0·15	0·11	0·09	0·07	0·07	0·09	0·08	0·09	0·08
0·2	0·11	0·09	0·07	0·07	0·09	0·08	0·09	0·08
0·25	0·11	0·09	0·08	0·07	0·10	0·09	0·10	0·09
0·3	0·11	0·09	0·08	0·08	0·11	0·09	0·11	0·09
0·4	0·12	0·10	0·08	0·08	0·12	0·10	0·12	0·10
0·5	0·13	0·11	0·09	0·09	0·13	0·11	0·12	0·11
0·6	0·14	0·12	0·09	0·09	—	—	—	—
0·75	0·15	0·13	0·10	0·10	—	—	—	—
			VARNISHED CAMBRIC INSULATED.					
0·0225	0·13	0·10	0·06	0·06	0·06	0·06	0·06	0·06
0·03	0·13	0·10	0·06	0·06	0·07	0·06	0·06	0·06
0·04	0·13	0·10	0·06	0·06	0·07	0·07	0·07	0·06
0·06	0·13	0·10	0·06	0·06	0·08	0·07	0·07	0·07
0·075	0·13	0·10	0·07	0·06	0·08	0·07	0·08	0·07
0·1	0·13	0·10	0·07	0·07	0·08	0·08	0·08	0·07
0·15	0·13	0·10	0·07	0·07	0·09	0·08	0·09	0·08
0·2	0·13	0·10	0·07	0·07	0·10	0·09	0·10	0·08
0·25	0·13	0·10	0·08	0·07	0·10	0·09	0·10	0·09
0·3	0·13	0·10	0·08	0·08	0·11	0·10	0·11	0·09
0·4	0·14	0·11	0·09	0·08	0·12	0·11	0·12	0·10
0·5	0·14	0·12	0·09	0·09	0·13	0·11	0·13	0·11
0·6	0·15	0·13	0·09	0·09	—	—	—	—
0·75	0·17	0·14	0·10	0·10	—	—	—	—

NOTES.—D is the thickness of the dielectric as follows :—

(1) Single-Core Cables, 3-phase centre point not earthed system : Between the Conductor and Metallic Sheath.

(2) Three-Core Cables, centre point not earthed : Between the Conductors and between any Conductor and Metallic Sheath.

(3) Three-Core Cables, centre point earthed : Between the Conductors only.

E is the thickness of the dielectric as follows :—

(1) Single-Core Cables, 3-phase centre point earthed system : Between the Conductor and Metallic Sheath.

(2) Three-Core Cables, centre point earthed : Between any Conductor and Metallic Sheath.

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TABLE IX.

SIZES OF GALVANIZED STEEL WIRE AND THICKNESS OF BEDDING FOR SINGLE-WIRE AND DOUBLE-WIRE ARMOURING.

Nominal Diameter of Cable to be Armoured, exclusive of Bedding.		Nominal Diameter of Galvanized Steel Wire.	Nominal Thickness of Bedding before the Armouring is applied.
Above.	Up to and including.		
1.	2.	3.	4.
in.	in.	in.	in.
—	0·5	0·048	0·04
0·5	0·8	0·064	0·06
0·8	1·05	0·080	0·1
1·05	2·0	0·104	0·1
2·0	—	0·128	0·1

TABLE X.

MINIMUM INSULATION RESISTANCE VALUES FOR 250 VOLT AND 660 VOLT VULCANIZED-RUBBER-INSULATED CABLES.

Nominal Area of Conductor.	Number and diameter of wires (or equivalent strand in flexible cables).	Insulation resistance for 1,000 yards at 60°F. (15·6°C.)
1.	2.	3.
		megohms.
0·0015	1/·044	3,000
0·002	3/·029	2,400
0·003	3/·036	2,100
0·003	1/·064	2,100
0·0045	7/·029	2,000
0·007	7/·036	1,800
0·01	7/·044	1,600
0·0145	7/·052	1,500
0·0225	7/·064	1,300
0·03	19/·044	1,200
0·04	19/·052	1,100
0·06	19/·064	1,000
0·1	19/·083	950
0·15	37/·072	850
0·2	37/·083	850
0·3	37/·103	800
0·4	61/·093	750
0·5	61/·103	700
0·75	91/·103	650
1·0	127/·103	600

TABLE XI.

MAXIMUM SPACING OF CLIPS SECURING LEAD-ALLOY-SHEATHED, VULCANIZED-RUBBER-SHEATHED ("H.R." TYPE), OR ARMOURED CABLES.

Overall Diameter of Cable. 1.	Sheathed. 2.	Armoured. 3.
	inches.	inches.
Under 0·3 inch ...	8	10
0·3 inch and under 0·5 inch	10	12
0·5 inch and under 0·75 inch	12	14
0·75 inch and under 1·25 inches ...	14	16
1·25 inches and above	16	18

TABLE XII.

APPROXIMATE CURRENT RATING OF FUSE-ELEMENTS COMPOSED OF TINNED COPPER WIRE OR STANDARD ALLOY* WIRE IN SEMI-ENCLOSED FUSES.

Current Rating	Tinned Copper Wire		Standard Alloy* Wire	
	Diameter	S.W.G.	Diameter	S.W.G.
1.	2.	3.	4.	5.
amps.	in.		in.	
1·8	—	—	0·0164	27
3·0	0·006	38	0·0240	23
5·0	0·0084	35	0·0320	21
8·5	0·0124	30	—	—
10·0	0·0136	29	—	—
15·0	0·020	25	—	—
17·0	0·022	24	—	—
20·0	0·024	23	—	—
24·0	0·028	22	—	—
30·0	0·032	21	—	—
37·0	0·040	19	—	—
46·0	0·048	18	—	—
53·0	0·048	18	—	—
60·0	0·056	17	—	—
64·0	0·056	17	—	—
83·0	0·072	15	—	—
100·0	0·080	14	—	—

NOTE.—The current ratings given in Table XII refer to the normal maximum current of the circuit and do not refer to the overload at which the fuse will operate.

The values of the currents given in Table XII are approximately those necessary to comply with Appendix 5 applied to the above fuse-elements used in semi-enclosed fuses. Where fuses are known to conform to this Appendix the size stated by the manufacturer on the case of the fuse should be adhered to in preference to that given in Table XII, if the fuse is loaded to its full capacity.

* The term "Standard alloy" refers to the eutectic tin-lead alloy (63 per cent tin, 37 per cent lead).

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TABLE XIII.

STANDARD SIZES OF DIRECT CURRENT AND ALTERNATING CURRENT (3-PHASE) MOTORS WITH CORRESPONDING APPROXIMATE FULL-LOAD CURRENTS.

(*See* Section 6, clause 5(*c*) and Section 13, clause 8.)

Output of Motor.	Direct Current. Full-Load Current.		Three-Phase Alternating Current. Full-Load Current.	
	110 Volts.	220 Volts.	230 Volts	400 Volts.
1.	2	3.	4.	5.
B.H.P.	Amps.	Amps.	Amps.	Amps.
0·25	3·2	1·6	—	—
0·5	5·7	2·8	2·5	1·4
1·0	10	5·0	3·8	2·5
2·0	18	9·0	6·7	4·0
3·0	26	13	9·5	5·5
4·0	35	17	12	7
5·0	42	21	15	9
7·5	61	30	22	12
10	80	40	29	16
12·5	100	50	35	20
15	117	59	42	24
20	155	77	55	31
25	190	95	67	38
30	227	114	77	45
35	264	132	89	51
40	300	150	101	58
45	340	170	113	64
50	375	187	125	72
60	450	225	150	87
70	520	260	175	102
80	595	298	200	116
90	665	333	224	128
100	740	370	244	140
125	900	450	298	172
150	—	550	352	203

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TABLE XIV.

CALCULATION OF MAXIMUM CURRENT WHICH WILL NORMALLY FLOW IN AN INSTALLATION TO A GROUP OF CARGO-WINCHES OR CRANES (FOR USE IN COMPUTING THE SIZES OF CABLES, SWITCHGEAR, ETC.). (*See* Section 6, clause 6 (*b*)).

Number of Winch Motors or Crane Motors supplied by the Circuit. 1.	Current to be provided for 2.
Two.	100% F.L. of the larger motor + 30% F.L. of the 2nd motor or 65% of the combined F.L. if the motors are of equal size.
Three.	100% F.L. of the largest motor + 25% F.L. of each of the remaining motors, or 50% of the combined F.L. if the motors are of equal size.
Four.	100% F.L. of the largest motor + 20% F.L. of each of the remaining motors, or 40% of the combined F.L. if the motors are of equal size.
Five.	100% F.L. of the largest motor + 20% F.L. of each of the remaining motors, or 36% of the combined F.L. if the motors are of equal size.
Six or more.	33% of the combined F.L. of the motors.

NOTE.—The letters "F.L." in Table XIV refer to the full-load current of the motor at its maximum brake-horse-power rating.

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TABLE XV.

TEMPERATURE LIMITS FOR COILS OF CONTROL GEAR.

Insulating Material. 1.	Total Temperature.		Maximum Temperature Rise [see Section 13, Clause 2(c)]	
	Shunt Coils. 2.	Series Coils. 3.	Shunt Coils. 4.	Series Coils. 5.
Class O. Cotton, silk, paper, and similar materials, non-impregnated.	176°F. (80°C.)	194°F. (90°C.)	72°F. (40°C.)	90°F. (50°C.)
Class A. (1) Cotton, silk, paper, and similar materials when impregnated or oil immersed; also enamel used with any of the above	194°F. (90°C.)	212°F. (100°C.)	90°F. (50°C.)	108°F. (60°C.)
(2) Enamelled wire not in association with such fibrous material	230°F. (110°C.)	248°F. (120°C.)	126°F. (70°C.)	144°F. (80°C.)
Class B. Built up asbestos, mica, and similar materials and bare coils	284°F. (140°C.)	302°F. (150°C.)	180°F. (100°C.)	198°F. (110°C.)
Class D. Coils with synthetic resin impregnation	230°F. (110°C.)	248°F. (120°C.)	126°F. (70°C.)	144°F. (80°C.)

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APPENDICES Nos. 1, 2, 3, 4, 5, 6 AND 7.

IN CONNECTION WITH THE RULES FOR ELECTRICAL EQUIPMENT AND ELECTRIC PROPELLING MACHINERY.

APPENDIX 1.

BUSBARS AND CONNECTIONS.

1. **Material.**—The copper used is to have a conductivity for annealed copper not less than 99·25 per cent, and for medium hard and hard copper not less than 95 per cent of the International Standard for standard annealed copper.

2. **Joints.**—All joints between copper conductors are to be made after dip-tinning or coating with petroleum jelly, or have equally effective treatment for preventing deterioration of the joint.

All joints, whether soldered or not, are to have the parts mechanically secured together.

3. **Limits of Temperature Rise.**—The following temperature limitations, measured by thermometer or thermocouple, are to apply to bare conductors in contact with air, when carrying their full rated current.

(*a*) Conductors rated 2,000 amps. and below, maximum temperature 158° F. (70° C.). Maximum temperature rise 72° F. (40° C.).

(*b*) Conductors rated above 2,000 amps., maximum temperature 176° F. (80° C.). Maximum temperature rise 90° F. (50° C.).

4. **Thermal Expansion.**—Where necessary, provision is to be made to allow for expansion and contraction due to temperature variations.

5. **Clearance Distances.**—The clearance distances specified below apply only to busbars having no insulating covering other than the surrounding air, compound or oil.

Max. Rated Voltage between Phases or Poles.	Minimum Clearance to Earth.		Minimum Clearance between Phases or Poles.	
	In Air.	In Oil or Compound.	In Air.	In Oil or Compound.
	inches.	inches.	inches.	inches.
660	$\frac{5}{8}$	—	$\frac{3}{4}$	—
2,200	$1\frac{1}{2}$	—	$1\frac{1}{2}$	—
3,300	2	$\frac{1}{2}$	2	$\frac{3}{4}$
6,600	$2\frac{1}{2}$	$\frac{3}{4}$	$3\frac{1}{2}$	1

IMPORTANT NOTE.—The above figures do not apply to creepage distance along the surface of insulators or of insulating bases.

6. **Mechanical Strength.**—The busbars and connections are to be so proportioned and supported as to be capable of safely withstanding the maximum mechanical stresses to which they may be subjected by the initial value of the short circuit current.

APPENDIX 2.

INSULATING MATERIALS.

1. **Classification of Materials.**

A. For the purpose of these Rules the following International designations will apply.

Class O. Cotton, silk, paper and similar organic materials when neither impregnated nor immersed in oil.

Class A. Cotton, silk, paper and similar organic materials when impregnated or immersed in oil, also the substance known as enamel applied to enamelled wire.

NOTE.—Impregnated cotton, paper or silk (also compound treated insulation).—An insulation is considered to be "impregnated" when a suitable substance replaces the air between its fibres, even if this substance does not completely fill the spaces between the insulated conductors. The impregnating substance, in order to be considered suitable, must have good insulating properties, must entirely cover the fibres and render them adherent to each other and to the conductor, must not produce interstices within itself as a consequence of evaporation of the solvent or through any other cause, must not flow at the temperature limit specified, must not unduly deteriorate under prolonged action of heat.

Class B. Mica and asbestos and similar inorganic materials in built up form combined with binding cement. If *Class A* material is used in small quantities for structural purposes only, in conjunction with *Class B* insulation, the combined materials may be considered as *Class B*, provided the electrical and

mechanical properties of the insulated winding are not impaired by the application of the temperature permitted for *Class B* material. (The word "impair" is here used in the sense of causing any change which could disqualify the insulating material for continuous service.)

Class C. Mica, without binding cement, porcelain, glass, quartz and other similar materials.

Class D. Coils insulated with synthetic resin impregnation.

B. Insulation made up of Different Materials.—When the insulation is made up of different materials (except in those cases defined under *Class B*) the temperature rise attained by each material is not to exceed the limit permitted for that material.

EXAMPLES.

(*a*) When the different insulating materials are used on various parts of one winding (for instance, in the slot and for the end windings) the limit of temperature rise applicable to any part of the winding is that set for the insulation used on the part.

(*b*) When the insulation on any part consists of superposed layers of insulating materials falling in different classes (for instance, superposed layers of *Class A* and *Class B* material) the two following cases arise.

(i) If it is possible to measure the temperatures attained by the various layers, each of the materials is entitled to the temperature rise which is assigned to it.

(ii) If it is not possible to measure the temperatures attained by the various layers, the temperature rise applicable to the part of the winding under consideration is to be taken as that for the insulating material with the lowest limit.

2. **Synthetic Insulating Boards, Tubes, etc., used for terminal boards and for mounting the live metal parts of switchgear and control gear.**—Material used for insulation slabs for switchboards, section boards, distribution fuse boards, terminal boards of apparatus and machines and similar applications is to be suitable for the purpose intended and is to be submitted for approval. Results of tests indicating the suitability of the material are to be submitted, the nature of which will depend on the application proposed. The materials are to be of first class quality and, where relevant approved National Standards exist, they are to comply with such standards. In general the tests should indicate the properties of the materials in relation to the following:—

A. INSULATION PROPERTIES.

(*a*) Surface insulation resistance.

(*b*) Surface breakdown.

(*c*) Di-electric strength.

These tests should preferably be carried out in an atmosphere of controlled temperature and humidity and, in certain cases, after immersing the sample in water.

B. WATER ABSORPTION.

C. MECHANICAL PROPERTIES.

D. HEAT RESISTANCE.

(*a*) Mechanical strength when heated within the limits of the working temperatures.

(*b*) Softening or tendency to flow or warp under combined heat and mechanical stress.

E. INFLAMMABILITY.—Self-extinguishing, non-inflammable or non-ignitable properties when heated by a Bunsen flame.

APPENDIX 3.

MOTORS AND GENERATORS FOR POWER AND LIGHTING SERVICES AND EXCITERS, BALANCERS AND BOOSTERS IN CONJUNCTION WITH ELECTRICAL PROPELLING MACHINERY.

1. **Limits of Temperature Rise.**—(*a*) Except for all ocean-going ships and ships operating in tropical waters, or where machines are fitted in specially hot situations, the temperature rises for which are specified in Section 2, clauses 2 and 3, and Section 12, clauses 1 and 2, of the Rules for Electrical Equipment, and Section 6, clause 6, of the Rules for Propelling Machinery, the temperature rise at rated load measured by thermometer, when tested under working conditions, is not to exceed the following limits.

TABLE I.

LIMITS OF PERMISSIBLE TEMPERATURE RISE.

Item.	Part of Machine.	Machines not Totally Enclosed.				Totally Enclosed Machines.	
		Class A Material.		Class B Material.		Class A Insulation.	Class B Insulation.
		By Thermometer method. 1.	By Resistance method. 2.	By Thermometer method. 3.	By Resistance method. 4.	By Thermometer method. 5.	By Thermometer method. 6.
1.	A.C. windings of stators or rotors.	72° F. (40° C.)	81° F. (45° C.)	90° F. (50° C.)	117° F. (65° C.)	90° F. (50° C.)	117° F. (65° C.)
2.	Field windings, rotating.		90° F. (50° C.)	*	108° F. (60° C.)	*	
3.	Field windings, stationary.	72° F. (40° C.)	*	90° F. (50° C.)	*	90° F. (50° C.)	117° F. (65° C.)
4.	Low resistance field windings of more than one layer or compensating windings.	81° F. (45° C.)	*	99° F. (55° C.)	*		
5.	Single layer field windings with exposed bare copper surface.	90° F. (50° C.)		117° F. (65° C.)	117° F. (65° C.)	90° F. (50° C.)	153° F. (85° C.)
6.	Short-circuited windings, insulated.	90° F. (50° C.)	*	117° F. (65° C.)	*		
7.	Windings of armatures having commutators.	72° F. (40° C.)	*	90° F. (50° C.)	*	90° F. (50° C.)	117° F. (65° C.)
8.	Commutators ...	81° F. (45° C.)		81° F. (45° C.)		99° F. (55° C.)	99° F. (55° C.)
	Slip rings (open) ...	81° F. (45° C.)		81° F. (45° C.)		99° F. (55° C.)	99° F. (55° C.)
	Slip rings (enclosed)	99° F. (55° C.)		99° F. (55° C.)		99° F. (55° C.)	108° F. (60° C.)
9.	Short-circuited windings, un-insulated.	The temperature rise of these parts is in no case to reach such a value that there is risk of injury to any insulating or other material on adjacent parts.					
10.	Iron core and other parts not in contact with windings.						
11.	Iron core and other parts in contact with windings.	The same limits of temperature rise as permitted for adjacent parts as given in Cols. 1 and 3 (or Cols. 2 and 4) in case of Item 2.					

* This method of measurement is not recognised in these cases.

(*b*) TEMPERATURE OF COOLING AIR.—The temperature of the cooling air for open type machines is to be measured by means of several thermometers at different points around and half way up the machine situated at distances of three to six feet away from it.

2. Overloads in Current and Torque.—Generators and motors are to be capable of carrying, without injury, the following overloads in current and torque respectively after having attained the temperature rise corresponding to their rated load, the voltage and frequency being maintained at their rated values. Sustained overloads are not recognised for the following types of machines:—

(*a*) Totally enclosed.

(*b*) Short time rated.

MOTORS with continuous rating are to withstand the following overloads in torque.

(i) Sustained overloads:—

Sizes 10 B.H.P. and upwards per 1,000 r.p.m. ... ... 25 per cent for two hours.

Sizes 4 B.H.P. up to 10 B.H.P. per 1,000 r.p.m. ... ... 25 per cent for one half-hour.

Sizes below 4 B.H.P. per 1,000 r.p.m. ... 25 per cent for 15 minutes.

(ii) Momentary overloads:—

All sizes ... ... 50 per cent for one minute.

D.C. motors up to 150 B.H.P. per 1,000 r.p.m. ... ... 100 per cent for 15 seconds.

A.C. motors, all sizes. 100 per cent for 15 seconds.

GENERATORS with continuous rating are to withstand the following overloads in current.

(i) Sustained overloads:—

Sizes $7\frac{1}{2}$ Kw. or K.V.A. per 1,000 r.p.m. and upwards. 25 per cent for 2 hours.

Sizes 3 to $7\frac{1}{2}$ Kw. or K.V.A. per 1,000 r.p.m. ... ... 25 per cent for one half-hour.

Sizes below 3 Kw. or K.V.A. per 1,000 r.p.m. ... ... 25 per cent for 15 minutes.

(ii) Momentary overloads:—

All sizes ... ... 50 per cent for one minute.

NOTE.—The B.H.P. or K.V.A. per 1,000 r.p.m. $= \frac{\text{Rated B.H.P. or K.V.A. (or Kw. if D.C.)} \times 1{,}000}{\text{Rated Speed.}}$

3. Method of Temperature Measurement.—The method to be used in any particular case is stated in clauses (*a*), (*b*) and (*c*) below.

(*a*) EMBEDDED TEMPERATURE DETECTORS (E.T.D.). This method is to be employed for the slot position of stator windings of the following types of machine:—

(i) Machines having a rated output of 5,000 K.V.A or more.

(ii) Machines having an axial core length of one metre or over.

(*b*) THERMOMETER METHOD. Mercury or alcohol bulb thermometers are to be employed, the latter being used where the magnetic field in the vicinity of the thermometers alternates or rotates. The temperatures are to be measured by thermometers applied to the hottest accessible surfaces of the stationary parts of the machine during the test period and other thermometers to the accessible surfaces of the rotating parts

as soon as the machine is stopped after the test. The bulb of the thermometer, except at the point of contact, is to be covered with a pad of felt, cotton wool or other non-conducting material $\frac{1}{8}$ inch thick, extending at least $\frac{3}{4}$ inch in every other direction from the bulb and pressed into contact to prevent the loss of heat by radiation and convection from the bulb.

(*c*) RESISTANCE METHOD. The measurement of temperature rise by increase of resistance is applicable to all field windings (except stationary low resistance field windings and exciter field windings) and to stator windings not requiring the use of E.T.D. It is not to be used for the alternating current windings of machines requiring more than 5 minutes to come to rest. Resistance measurements are to be made before and at the conclusion of the temperature test.

4. **Duration of Temperature Test.**—The temperature test for a machine having a continuous rating is to be of such duration that sufficient evidence is available to show that the temperature rise would not exceed the permissible limits were the test prolonged until a final steady temperature was reached. It is in no case necessary to prolong the test after a steady temperature rise has been reached. The duration of the temperature test for a machine having a short time rating is to be the time required for the rating.

5. **Temperature for a Machine having more than one Rating.**—When a machine has more than one rating, the temperature test is to be carried out at that rating which produces the greatest temperature rise. In cases where this cannot be determined beforehand, the machine is to be tested separately under each of its ratings.

6. **Commutation.**—A D.C. machine is to work with fixed brush setting from no load to the momentary excess current or torque specified and is to work sparklessly and without injury to the commutator or brushes from no load to the rated load and without injurious sparking or injury to the commutator or brushes up to the momentary excess current or torque specified. The commutation test is to be applied at the conclusion of the temperature test.

7. **Regulation.**—The voltage regulation test on generators and speed/load characteristics of motors are to be carried out at the conclusion of the temperature tests.

8. **High Voltage (Dielectric) Tests.**—The high voltage tests, in accordance with **Table II** below, are to be applied only to new and completed machines in normal working condition with all parts in place, at the makers' works, preferably at the conclusion of the temperature test. It is to be applied between the terminals and the frame with the core connected to the windings not under test. The test is to be made with alternating voltage of any convenient frequency between 25 and 100 cycles per second, of approximately sine-wave form. The test is to be commenced at a voltage of about one-third the test voltage and is to be increased to the full test voltage as rapidly as is consistent with its value being indicated by the measuring instrument. The full test voltage is then to be maintained for one minute and then reduced to one-third of its full value before switching off.

TABLE II.

HIGH VOLTAGE TESTS.

ITEM NO.	MACHINE OR PART.	TEST VOLTAGE.
1.	Machines under 3 B.H.P./ Kw. / K.V.A. per 1,000 r.p.m.	1,000 v. + twice the rated voltage.
2.	Machines 3 B.H.P. / Kw./ K.V.A. and above per 1,000 r.p.m.	1,000 v. + twice the rated voltage—minimum 2,000 v.
3.	Field windings for synchronous generators when the excitation voltage does not exceed 750 v.	10 times the excitation voltage—minimum 2,000 v., maximum 3,500 v.
4.	Field windings for synchronous motors :	
	(*a*) when intended to be started up with the field windings short-circuited or connected across the exciter armature.	10 times the excitation voltage—minimum 2,000 v., maximum 3,500 v.
	(*b*) when intended to be started up with the field windings separated by a field dividing switch.	5,000 v.
	(*c*) when intended to be started up with the fields on open circuit and without a field-dividing switch.	5,000 v. when the excitation voltage is less than 275 v. 8,000 v. when the excitation voltage is equal to or exceeds 275 v.
5.	Field windings for synchronous motors when intended to be started up with A.C. windings idle.	As for 4(*a*).
6.	Exciter	Not less than that applied to the field windings of the machine to which it is connected, except when used with a synchronous machine intended to be started up from the alternating current side, in which case the test will be as given in Item 4(*a*) above.
7.	Secondary (rotor) windings of induction motors not permanently short-circuited.	For non-reversing motors :— 1,000 v. + twice the maximum voltage induced between slip rings. For reversing motors :— 1,000 v. + four times the maximum voltage induced between the slip rings at standstill with full primary voltage applied to stator windings.

9. **Supplementary High Voltage (Dielectric) Tests.**—When for any reason it is desired to make additional high voltage tests on a machine which has already passed its tests in accordance with clause 8 above and when installed on site such additional high voltage tests are to be made in accordance with the requirements of clause 8, except that the voltage is to be 75 per cent of that specified above. Before the high voltage test is applied, the windings are to be cleaned and, if necessary, dried out.

10. **Insulation Resistance.**—The insulation resistance in megohms when the high voltage test is applied is not to be less than :—

$$\frac{3 \times \text{rated volts}}{1{,}000 + \text{rated output in K.V.A. or B.H.P.}}$$

The insulation resistance is to be measured with a D.C. voltage of about 500, preferably at the conclusion of the temperature test of the machine.

11. **Abbreviated Tests.**—In the case of duplicate machines up to 50 Kw./B.H.P. per 1,000 r.p.m. type tests of temperature rise, excess current and torque and commutation taken on a machine identical in rating and in all other essential details may be accepted in conjunction with abbreviated tests on each machine. For the abbreviated tests each machine is to be run and is to be found electrically and mechanically sound and in working order in all particulars, and is to have a high voltage (dielectric) test and insulation resistance test.

APPENDIX 4.

MAIN ALTERNATORS, MOTORS AND DIRECT-CURRENT GENERATORS FOR ELECTRIC PROPULSION PURPOSES. (Continuous Maximum Rating.)

1. **General.**—Generators and motors for electric propulsion purposes are to conform in all respects to the requirements of Appendix 3, except as modified hereunder.

2. **Rating.**—The continuous maximum rating is the load which can be carried on test for an unlimited period without exceeding the specified limits of temperature rise.

3. **Limits of Temperature Rise.**—The following limits of temperature rise apply only to machines for electric propulsion purposes, having a maximum continuous rating, provided no sustained overloads are thrown upon it under normal service conditions.

TABLE I.

LIMITS OF PERMISSIBLE TEMPERATURE RISE.

Item.	Part of Machine.	Class A Material.		Class B Material.			
						By E.T.D.	
		By Thermometer method. 1	By Resistance method. 2	By Thermometer method. 3	By Resistance method. 4	(*a*) (see below.) 5	(*b*) (note below.) 6
1.	A.C. windings of stators or rotors.	81° F. (45° C.)	90° F. (50° C.)	99° F. (55° C.)	126° F. (70° C.)	126° F. (70°C)	108°F. (60°C)
2.	Field windings (other than 3, 4 & 5).	*	90° F. (50° C.)	*	126° F. (70° C.)	*	*
3.	Low resistance field windings of more than one layer, or compensating windings.	90° F. (50° C.)	*	108° F. (60° C.)	*	*	*
4.	Single layer field windings with exposed bare copper surface.	99° F. (55° C.)	99° F. (55° C.)	135° F. (75° C.)	135° F. (75° C.)	*	*
5.	Rotating field windings of high speed turbine driven alternators.	*	90° F. (50° C.)	*	144° F. (80° C.)	*	*
6.	Short circuit windings insulated.	99° F. (55° C.)	*	135° F. (75° C.)	*	*	*
7.	Windings of armatures having commutators.	81° F. (45° C.)	*	99° F. (55° C.)	*	*	*
8.	Short circuited windings un-insulated.	The temperature rise of these parts is in no case to reach such a value that there is a risk of injury to any insulating or other material on adjacent parts.					
9.	Iron core and other parts not in contact with windings.						
10.	Iron core and other parts in contact with windings.	The same limits of temperature rise as permitted for adjacent parts as given in Cols. 1 and 3 (or 2 and 4 in the case of Item 2).					
11.	Commutators	81° F. (45° C.).					
	Slip rings (open)	81° F. (45° C.).					
	Slip rings (enclosed) ...	90° F. (50° C.).					

(*a*) Between coils in one slot.
(*b*) Between outside of coil and bottom of slot.
* This method of measurement is not recognised in these cases.

4. **Excess Current and Torque**—(*a*) Generators are to be capable of withstanding on test for 15 seconds a current in amperes 50 per cent in excess of their rated current, the voltage being maintained as near the rated output as possible consistent with the maximum capacity of the prime mover. The exact value of the voltage is not important.

(*b*) Direct current motors are to be capable of withstanding on test for 15 seconds a torque 50 per cent in excess of that corresponding to their rating, the voltage being maintained at rated value.

(*c*) Synchronous motors are to be capable of withstanding for 15 seconds without dropping out of synchronism a torque 50 per cent in excess of the torque corresponding to their rating, the voltage and frequency of the A.C. system with which they are synchronised being maintained at their rated values

and the excitation of the motor being maintained at the value required to meet the specified conditions at rated load.

(*d*) Induction motors are to be capable of withstanding for 15 seconds without stalling a torque 50 per cent. in excess of the torque corresponding to their rating, the voltage and frequency being maintained at their rated values.

5. **Short Circuit Test on Alternators.**—Alternators are to be capable of withstanding a momentary short circuit at the terminals of the machine applied when generating normal full rated voltage.

6. **Tests.**—All machines are to be tested at the manufacturers' works in the presence of the Surveyors. Where the machines are too large to carry out a temperature test at full load, proposals for equivalent tests are to be submitted for consideration. The high voltage and insulation tests and methods of temperature measurement are to be in accordance with Appendix 3.

Exciters and machines connected therewith, irrespective of rating, are also to be tested in the presence of the Surveyors.

APPENDIX 5.

FUSES.

1. **Current Rating.**—The current rating of a fuse is the current which the fuse will carry continuously without deterioration, and at which the specified temperature rise at any part does not exceed that specified in clause 6 below.

The term "fuse" includes all parts of the device, i.e., the fuse-element, contacts, carrier, base and terminals.

2. **Fusing Factor.**—The fusing factor is the ratio of the minimum fusing current to the current rating and is not to exceed 1·75 for fuses up to 60 amperes rating, and for fuses rated above 60 amperes is not to exceed 2·0 for fuses in category of duty 2 or 1·75 for fuses in categories of duty 3 and 4. The minimum fusing current is the minimum current that will melt the fuse-element.

3. **Category of Duty.**—Approved fuses will be assigned for convenient reference a category of duty derived from the breaking capacity tests, and a fuse is not to be installed in any circuit having a prospective short circuit current in excess of that for which the fuse is assigned. The prospective short circuit current is the current which would flow through a short circuit applied to the supply terminals of the fuses under normal working conditions. The following categories of duty will be recognised as standard :—

Category of Duty.	Maximum Prospective Current of Test Circuit (amperes).
1	1,000
2	4,000
3	16,500
4	33,000

Fuses having a rated breaking capacity intermediate between these values will be assigned to the next lower category.

Fuses connected to the busbars of main switchboards, i.e., those busbars to which the generators are connected, are not to be used with generators having a greater total output under working conditions than that corresponding to the category of duty as shown in the following schedule :—

Category of Duty of Fuse.	Maximum Total Kw. Capacity of Generators, under working conditions.		
	100–125 Volts D.C.	200–250 Volts D.C.	3–phase 440 Volts A.C.
1	60	100	300
2	250	400	1,000
3	1,200	2,000	5,000
4	over 1,200	over 2,000	over 5,000

The fuses installed on section boards and distribution fuse boards will generally be of the same category of duty as on the main switchboard, but in special cases they may be of a lower category based on the prospective short circuit current at the position at which they are connected.

4. **General Construction.**—The contacts are to be so constructed and of such material that sufficient pressure is maintained under ordinary service conditions after repeated engagement and disengagement and when left untouched for long periods. Fuse links are to be such that overheating, arcing and scattering of hot metal or other substances is obviated. All non-metallic parts are to be constructed of non-ignitable, non-hygroscopic insulating material, provided that cartridges with their attached labels need not necessarily be non-ignitable, and that tubular linings, if any, enclosing fuse elements, linings of containing cases or covers, if any, and fillers of cartridges, need

not of necessity be non-hygroscopic. The requirements of Section 3, clause 20, of the Rules for Electrical Equipment, are to be complied with.

5. Approval.—In order to secure approval of fuses a report, preferably by an independent authority, is to be submitted for consideration, giving details of performance, fusing characteristics, temperature and insulation tests, and accompanied by outline drawings. The drawings should indicate the general arrangement and leading dimensions, including dimensions of contacts and terminals. Samples should not be submitted unless specially requested.

Fuses will be approved for standard direct current voltages up to 250, and alternating current voltages up to 440, and a list of approved fuses will be issued.

6. Temperature Rise.—Fuses are to be tested in surroundings free from external draughts and in the containing cases, if any, in which they may be used in service and in the position in which they will normally be mounted. The maximum temperature rises of contacts and fixed terminals, at the top of fuses if mounted vertically, are to be measured by thermo-couples attached by means of low-melting-point alloy, applied to those points at which the maximum temperature rises may be expected to occur. Thermo-couples of copper-constantan, and an alloy of equal parts of lead, tin and bismuth are suitable.

The temperature rise of cable terminals when they are attached to rubber-insulated cables is not to exceed 30° C. for fuses rated not more than 150 amperes, or 35° C. for fuses rated above 150 amperes. The temperature rise of contacts and fixed terminals other than those mentioned is not to exceed 55° C.

7. Performance (Breaking Capacity).—Fuses are to be type tested to ensure the satisfactory opening of the circuit when wired for their maximum current rating under conditions capable of producing the requisite prospective short circuit according to the category of duty.

The source of energy for the tests is to be capable of giving the specified current and is to produce a recovery voltage of not less than 95 per cent of 440 R.M.S. volts A.C. or 250 volts D.C. This recovery voltage is to be maintained for not less than 30 seconds immediately after the opening of the circuit by the fuse. The impedance of A.C. test circuits is to be appropriate to the required prospective current at a power factor as given below. If tested on a D.C. test circuit the resistance and inductance of the circuit is to be such that the circuit has a suitable time-constant as stated below.

Category of Duty.	Maximum Prospective Current of test circuit (amperes).	Power Factor (Lagging) not greater than	Time-constant (L/R) not less than
1	1,000	0·6	0·0030
2	4,000	0·4	0·0040
3	16,500	0·3	0·0060
4	33,000	0·3	0·0075

Semi-enclosed fuses are to operate successfully on test six times, and cartridge fuses three times, without the renewal of any parts other than the fuse-elements and the asbestos tubes or the like, if any.

Fuses are deemed not to comply with the requirements if, during one of these tests, any of the following failures occur:—

(*a*) The arc is maintained.

(*b*) Ignition of the fuses or ignition or damage of neighbouring apparatus, excluding any paper labels or the like used as indicating devices on the fuses.

(*c*) Mechanical damage sufficient to render any of the following parts unserviceable without repairs: fuse contacts, fuse carriers, fixed contacts, bases, cases or any other parts not intended to become unserviceable on the melting of the fuse-elements.

(*d*) In cartridge fuses, bursting of cartridges.

(*e*) Reduction of the insulation resistance between the cable terminals of the fuses to less than 100,000 ohms.

The test certificate should state whether the test has been carried out with A.C. or D.C.

8. Insulation Resistance.—The insulation resistance measured

(*a*) between the fixed terminals, and

(*b*) between live parts and the containing metal case, if any, with all other parts in position except the fuse-element, is to be not less than 50 megohms.

9. Marking.—Fuse carriers intended for use with semi-enclosed fuse-links, or alternatively the containing cases, if any, of semi-enclosed fuses, and cartridges

are to be indelibly marked with the maximum current rating (*see* clause 1) for which the fuses of which they form parts are suitable.

10. **British Standards.**—Fuses complying with the requirements of B.S.S. 88–1939 will be accepted as meeting the requirements of this Appendix, provided clause 4 above be complied with.

APPENDIX 6.

FLAMEPROOF ENCLOSURE.

Where apparatus is required to be of the flameproof type and apparatus of suitable type is obtainable which has been type-tested and approved by a competent independent Testing Authority, such as, in the United Kingdom, the Mines Department, such apparatus only is to be used. Where such apparatus is not obtainable, the flameproof enclosure is to comply with the following requirements.

1. **Definition.**—A flameproof enclosure (including explosion proof) is one which will withstand, without injury, any explosion of inflammable gas that may occur within it under practical conditions of operation within the rating of the apparatus (and recognised overloads, if any, associated therewith) and will prevent the transmission of flame such as will ignite the inflammable gas which may be present in the surrounding atmosphere.

NOTE.—Short of permanent hermetic sealing, which is generally impracticable, it must be assumed that any external explosive atmosphere may find its way within the enclosure and, moreover, that an ignitable atmosphere may be produced internally by the decomposition of oils, varnishes, rubber, etc. The term "gas-tight," therefore, has been deliberately discarded in favour of the term "flameproof."

2. **Flameproof Joints.**—All joints between sections or compartments, or between covers and compartments, are to be flanged joints of a type indicated below. Rubber, asbestos, or any material which is liable to deteriorate, or is capable of disintegration, is not to be used for the packing of joints. Bolts of sufficient size and number are to be used to prevent undue distortion of the flanges when the enclosure is subject to internal pressure due to an explosion.

(*a*) CLOSE METAL TO METAL FLANGED JOINTS. The surfaces of such flanges are to be machined and are to have a breadth of not less than one inch across metal faces and the presence of bolt holes may be disregarded in this measurement, provided that the minimum distance between the inner edge of the bolt hole and the inner edge of the flange is 0·375 inch. Where a spigot or similar method of construction is employed, the total length of the path need not be more than one inch, as specified above.

(*b*) VENTED FLANGED JOINTS. Pressure relief may be obtained by:—

(i) Flanged joints in which a gap is provided which is never to exceed 0·020 inch, even when the joint is stressed by internal pressure and in which the gap cannot be reduced so as to prevent pressure relief by the omission of any part after dismantling. The joint is preferably to be made close round the bolt holes for a radial distance of not less than 0·375 inch.

(ii) Pressure relief vents of an approved type.

(*c*) ATTACHMENT OF COVERS AND EXTERNAL AND/OR INTERNAL FITTINGS. If removable bolts, studs or screws are provided for attachment of any component parts of a flameproof enclosure, or for the attachment thereto of any external or internal fittings, the holes for the reception of such removable bolts, studs or screws are not to pass through the walls of the flameproof enclosure, and a thickness of metal is to be left at the bottom of any such hole of not less than $\frac{1}{8}$ inch or one-third of the diameter of the hole, whichever is the greater.

3. Shafts and Bearings.—(*a*) BALL AND ROLLER BEARINGS. Where ball and roller bearings are used and form an entry into a flameproof enclosure, the bearing housing is to be so constructed that over a total axial length of not less than 1 inch, excluding grooves for grease seals, the radial clearance around the shaft, if uniform, is not to be more than 0·010 inch, so that if the shaft becomes decentred from any cause the maximum clearance will not be more than 0·020 inch.

(*b*) SPINDLES. Where an operating spindle passes through the wall of a flameproof enclosure, it is to pass through a hole not less than one inch long, fitting as closely as circumstances permit. The radial clearance around the spindle, if uniform, is not to be more than 0·010 inch, as indicated above.

(c) JOURNAL SLEEVE BEARINGS. Where a rotating shaft running in oil lubricated journal bearings passes through the wall of a flameproof enclosure, it is to pass through an additional sleeve, labyrinth gland or equivalent device, having a clearance combined with the appropriate length of path sufficient to ensure flameproofness under the most extreme conditions of wear of the bearing that may occur in service. If a sleeve is adopted it must have a path not less than two inches long and a radial clearance, if uniform, of not more than 0·010 inch, as indicated above. In the case of special glands, where the clearances given above are exceeded, then such increase in the clearance is to be associated with an appropriate increase in the length of path, or equally adequate means of ensuring flameproofness and full details submitted for approval.

(d) STUFFING BOXES. In no case is a stuffing box or packed joint to be used as a flameproof seal for a shaft or spindle.

4. Terminals and Terminal Boxes.—(a) TERMINALS. Means for making connections to the external circuit are to be designed so as not to imperil the flameproof properties of the enclosure. The terminals are always to be outside the flameproof enclosure. The connections passing through the flameproof wall from the interior to the terminals are to be fitted with flameproof glands or bushes. The terminals are to be designed and spaced to allow for convenient handling during installation and use, and the leakage surfaces between the poles, and between the poles and the case, are to be adequate to provide against the danger of flash-over, leakage and short circuit.

Means are to be provided for securely locking the clamping nuts or screws which are used for securing the external conductors to the terminals.

(b) TERMINAL BOXES. A terminal box is to be a metallic box, either secured to or cast as part of the frame of the machine for the purpose of enclosing the live terminals forming the connections between the windings and the outside cables, and preventing the accumulation of dust or moisture. The terminal box or sealing chamber is to be so constructed that the external cables may be brought into the box in one of the following ways:—

(1) In gas-tight conduit.

(2) As lead-covered and armoured cables.

For armoured cables a substantial grip for the armouring, securely bolted to or screwed into the cable sealing chamber, is to be provided which must be earthed to the frame. All armour and lead sheath grips are to be either brass or machined and protected from rust.

5. Maximum Pressure Developed.—In unvented structures the maximum pressure to be expected with the most explosive methane-air mixture (9·5 per cent.) when ignited in a quiescent condition at atmospheric pressure by an electric spark is 110 lb. per square inch. Under certain conditions, however, such as internal sub-divisions in gaseous communication with one another, internal arcing or blowing of a fuse, turbulence, etc., this pressure may be exceeded.

6. Approval.—Where a certificate has been obtained from an independent Testing Authority it will be sufficient to furnish a copy of the relevant certificate, provided there is no departure from the design so tested and approved. In all other cases full details of the flameproof enclosure are to be submitted for approval.

APPENDIX 7.

TINNING TEST.

Any part of a tinned conductor removed from the core of the cable after the vulcanization process is complete is to satisfy the following tests:—

Samples of the tinned wire are to be selected and bent into circles, the diameter of the circles being between 24 and 30 times the diameter of the wire. After cleaning by immersion in benzine and rubbing with a pad of clean cotton wool or filter paper to remove any grease, the samples are to be dried in air and the part to be immersed in the test solution is not to be handled.

Each sample is then to be immersed in test solutions, as stated below, and maintained at a temperature of approximately 60° F. (15·6° C.). The cycle of operation is to be performed six times. Each cycle is to consist of:—

First: Immersion of the sample for one minute in hydrochloric acid, as defined on following page, the sample then being washed in clean water and wiped dry.

Second: Immersion of the sample for 30 seconds in sodium-polysulphide solution, as defined below, the sample then being washed in clean water and wiped dry.

The sample is then to be examined under a hand lens to ascertain if copper exposed through openings in the tin coating has been blackened by the action of the sodium-polysulphide. The sample is to be considered to have failed if, by such blackening, exposed copper is revealed.

In the event of only one sample of a set giving results widely dissimilar from the remaining samples discretion may be exercised with regard to this sample.

Testing Solutions. The hydrochloric acid solution is to have a specific gravity at 60° F. (15·6° C.) of 1·088.

A portion of hydrochloric acid solution having a volume of 180 ml. is to be considered to be exhausted when there has been immersed in it the following number of test-samples:—

DIAMETER OF WIRE.	Maximum number to be tested in 180 ml. of acid solution.
Up to and including 0·044 ins. ...	20
Above 0·044, up to and including 0·083 in.	12
Above 0·083 ins.	8

The sodium-polysulphide solution is to have a specific gravity at 60° F. (15·6° C.) of 1·142 and is to be made in the following manner:—

Dissolve about 25 grammes of pure sodium-sulphide crystals in distilled water and make up to 100 ml., add powdered sulphur in excess of the quantity required to saturate the solution (about 25 grammes per 100 ml.), and boil for about one hour with occasional stirring.

Cool and filter the solution and then dilute with distilled water to a specific gravity of 1·142 at 60° F. (15·6° C.).

71, Fenchurch Street, London, E.C.3.
17th October, 1946.

REFRIGERATING MACHINERY

AND

APPLIANCES OF SHIPS.

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RULES FOR REFRIGERATING MACHINERY AND APPLIANCES OF SHIPS.

GENERAL.

Section 1. 1. On the application of Owners of vessels intended to carry refrigerated cargoes, the Committee will authorise their Surveyors to survey the refrigerating machinery and appliances during construction and installation, and in those cases where the requirements of the Rules detailed below are complied with and a satisfactory report is received from the Surveyors, certificates of classification will be issued and the notation of ✠Lloyd'sRMC (*in red*) (*i.e.*, Lloyd's Refrigerating Machinery Certificate) will be made against the vessel's name in the Society's Register Book.

The Committee will also be prepared to authorise their Surveyors to survey existing installations for a notation of Lloyd'sRMC (*in red*) provided the requirements of the Rules for such installations be satisfactorily carried out.

The number of refrigerating units, number of compressors, the system of refrigeration, the name of the maker and date of the construction of the machines, the method employed for cooling the chambers and the nature of the insulation, and the refrigeration or ice melting capacity in tons per 24 hours, and the number and total capacity of the insulated cargo chambers in cubic feet, will be recorded in the special list of Vessels fitted with Refrigerated Appliances in the Register Book.

2. **Information to be Submitted.**—Where refrigerating machinery and appliances are to be built under Special Survey, the following information is to be forwarded for consideration before the construction of the installation is commenced:—

(*a*) Standard data sheet giving calculations of heat loading and machine output. (Copies of this data sheet may be obtained from the Society's local offices.)

(*b*) Detailed specification of the refrigerating machinery.

(*c*) Detailed specification of the insulation.

(*d*) The following plans and any other plans which may be specially requested :—

General arrangement of insulated chambers in elevation and plan.

Details of insulation showing thicknesses and methods of attachment of insulation and linings; method of attachment of meat rails, brine or direct expansion grids; details of insulated doors, hatch, bilge and manhole plugs.

Arrangement of air ducts.

Arrangement of chamber thermometers.

Arrangement of fan motors.

Arrangement of fans and coolers.

Brine circuit diagram.

General arrangement of refrigerating machinery.

Refrigerant gas and liquid circuit diagram.

Sectional arrangement of compressor.

Compressor crank shaft.

Compressor crank case where exposed to the pressure of the refrigerant gas.

Condenser.

Evaporator.

Details of pressure vessels.

3. **Special Cases.**—The Committee will be prepared to give consideration to cases of vessels engaged on voyages of short duration or to other special circumstances.

REFRIGERATING MACHINERY.

Section 2. 1. **Definition of a Unit.**—A refrigerating unit comprises a prime mover, one or more compressors, one condenser, one evaporator or cooler, and fittings necessary to form an independent gas and liquid system.

If the prime mover is a steam engine and each cylinder drives a corresponding compressor, or if there is more than one motor similarly arranged and each compressor is connected to its own condenser and evaporator or cooler (not necessarily in separate casings), these machines are to be

described as two or more units, as the case may be, provided each unit can be used either in combination or separately.

If a machine has more than one compressor, but is driven by a single prime mover and has only one condenser and one evaporator or cooler, it is to be described as one unit with one or more compressors.

In the case of compound compressors the high and low pressure cylinders are to be considered as a single compressor.

2. **Ice melting capacity.**—The refrigeration or ice-melting capacity of the machines in tons per 24 hours should be calculated at the rate of 318,080 B.T.U. per English ton (*i.e.*, 2,240 pounds) with temperature of evaporation = 5° F. (−15° C.), and temperature of liquid refrigerant in the condenser = 86° F. (30° C.).

3. **Power of Machinery.**—(*a*) The refrigerating machinery is to be of approved construction and of sufficient power to deal adequately with the cargo as received on board.

(*b*) Not less than two complete units of refrigerating machinery are to be fitted.

(*c*) When two units are fitted their working parts are to be interchangeable. Each unit is to be capable of maintaining the required temperatures in the cargo chambers when working 24 hours a day in the tropics.

(*d*) When more than two units are fitted, the power provided is to be such that the required temperatures can be maintained in the cargo chambers when working 24 hours a day in the tropics with any one unit out of action.

(*e*) In addition to the brine pumps and the gas condenser water circulating pump required for the maximum duty, a standby brine pump and water circulating pump are to be fitted, ready for use. The additional water circulating pump may be one of the pumps used for other purposes provided it is of adequate capacity and its use on the gas condenser does not interfere with other essential services. The circulating water is to be taken from two sea connections one of which may be the water ballast inlet.

(*f*) In any case where the total power is not available for all the insulated cargo chambers, the machinery serving each group of chambers is to comply with the foregoing requirements and the requirements for spare gear.

(*g*) Where the machinery is steam driven, the exhaust steam is to be led to the main and auxiliary condensers.

4. **Motive Power.**—The motive power is to be taken from at least two sources, each capable of the maximum duty without interference with other essential services.

5. **Location of Machinery.**—Where ammonia or methyl chloride refrigerant is used, the refrigerating machinery is to be placed in an efficiently ventilated compartment isolated from the propelling machinery spaces.

6. **Hydraulic and other Tests.**—In the case of new refrigerating machinery and appliances, the tests required are :—

(*a*) CO_2 compressors, intermediate liquid coolers, separators, condenser and evaporator coils, headers and connections, condensers and evaporators of the multitubular and double pipe types, to be tested by hydraulic pressure to 3,000 lb. per square inch, and afterwards by air pressure to 1,500 lb. per square inch whilst submerged in water at a temperature of 90° F.

(*b*) NH_3 compressors and cast iron or steel connections to be tested by hydraulic pressure to 600 lb. per square inch, and afterwards by air pressure to 300 lb. per square inch whilst submerged in water at a temperature of 90° F.

NH_3 crank cases which are subjected to gas pressure to be tested by hydraulic pressure to 300 lb. per square inch, and afterwards by air pressure to 150 lb. per square inch whilst submerged in water at a temperature of 90° F.

(*c*) NH_3 condenser, evaporator and air cooler coils to be tested by hydraulic pressure to 1,500 lb. per square inch, and afterwards by air pressure to 500 lb. per square inch whilst submerged in water at 90° F.

NH_3 condensers or evaporators of the multitubular, double pipe or shell and tube types and welded pressure vessels to be tested by hydraulic pressure to 500 lb. per square inch, and afterwards by air pressure to 250 lb. per square inch whilst submerged in water at 90° F.

Where it is inconvenient to test the larger sizes by submersion in water, the shells may be charged with air and NH_3 and tested by means of litmus paper or sulphur sticks.

(*d*) NH_3 condenser, evaporator and air cooler coils to be tested after erection in place by air pressure to 200 lb. per square inch.

(*e*) Brine piping after erection in place to be tested by hydraulic pressure to double the working pressure at the brine circulating pumps, but in any case not less than 50 lb. per square inch.

(*f*) Gas evaporator casings of cast iron and gas condenser casings, whether of cast iron or steel, to be tested by hydraulic pressure to 15 lb. per square inch, or to double the working pressure, whichever is the greater.

(*g*) Gas evaporator, wrought iron and steel casings, to be tested by hydraulic pressure to 30 lb., if gravitation type, or to 50 lb. per square inch if pressure type, or to double the working pressure, whichever is the greater.

(*h*) CCl_2F_2 (Freon 12) and CH_3Cl (Methyl Chloride), all parts exposed to the pressure of the refrigerant gas, with the exception of the compressor crank case, to be tested by oil pressure to 350 lb. per square inch, and afterwards by air or gas pressure to 200 lb. per square inch whilst submerged in water at a temperature of 90° F.

CCl_2F_2 and CH_3Cl crank cases which are subjected to gas pressure to be tested by water or oil pressure to 200 lb. per square inch, and afterwards by air or gas pressure to 150 lb. per square inch whilst submerged in water at a temperature of 90° F.

(*i*) Important steel castings and steel forgings are to comply with the requirements of **Sections 9** and **10**, respectively, of the **Rules for the Quality and Testing of Materials.**

Where refrigerant pipes are made of steel, the material is to comply with the requirements of **Section 16, clauses 1** and **2**, of the **Rules for the Quality and Testing of Materials.**

7. **Safety Valves.**—(*a*) Suitable spring-loaded safety valves are to be provided on condenser casings and evaporator casings of pressure type.

(*b*) A relief valve or safety disc is to be fitted on or near each compressor on the gas delivery side.

8. **Oil Separator.**—A suitable oil separator with drain to be fitted to the gas line near the compressor.

9. **Oil Engines.**—Where refrigerating machinery is driven direct by oil engines, the sizes of the crank shafts and particulars of the engines and of the proposed spare gear in connection therewith are to be submitted for consideration.

10. **Pressure Vessels.**—Welded pressure vessels exposed to the pressure of the refrigerant are to be constructed in accordance with the **Rules for Welded Pressure Vessels,** with the exception that hydraulic and air tests are to be carried out in accordance with **clause 5** above.

11. **Fans.**—Where air circulating fans for refrigerated chambers are electrically driven, the fan motors are to be inspected by the Surveyors during manufacture and testing irrespective of the horse-power rating of the motors.

The access arrangements to the fans are to be such that the fans and motors may be readily removed for repair or renewal when the chambers are loaded with refrigerated cargo.

12. **Cooling Tests.**—Upon completion of the installation under special survey the refrigerating machinery is to be tested under working conditions and the insulated chambers are to be cooled down simultaneously to about 10° F. where they are intended for carrying frozen and chilled meat cargoes, and to about 20° F. where they are intended for carrying fruit and similar produce which require only moderate temperatures. The rise of temperature in the refrigerated chambers is to be noted upon the expiration of about 12 hours time after the machinery and cooling appliances have been shut off.

INSULATION AND FITTINGS.

Section 3. 1. **Bulkheads.**—The transverse or longitudinal terminal bulkheads separating insulated from non-insulated compartments are to be of steel construction and hose-tested for tightness.

Where dis-similar cargoes may be carried in the separate compartments, the divisional bulkheads between the insulated compartments are to be of steel construction and hose-tested for tightness.

2. **Insulation.**—The insulation is to be sound and in good order and of efficient construction. The details of construction showing the amount and nature of the insulating material employed in the various parts are to be reported to the Committee.

3. **Protection of Insulation.**—The insulation of the lower hold chamber floor and the tunnel top in way of the hatchways and about two feet beyond are to be protected with hardwood sheathing about two inches thick or similar protection.

4. **Access Plugs.**—Insulated removable portions are to be arranged in the insulation, where required, to provide easy access to the bilges and bilge suction roses. Similar provision to be made for access to the tank air and sounding pipes.

5. **Oil Storage Tank Tops and Bulkheads.**—The insulation of all oil storage tank tops to have an air space of two inches provided between the under side of the insulation and the tank top plating and the supporting battens to be arranged athwartship to permit of free drainage to the bilges.

As an alternative to the air space, approved inodorous material not less than half inch in thickness may be laid on the tank top plating.

A cofferdam is to be fitted separating deep tanks intended for the carriage of oil from refrigerated compartments unless the tank bulkhead is wholly welded including its boundary connections, in which case the cofferdam may be omitted and an air space of not less than two inches arranged between the insulation and the bulkhead plating to provide for free drainage from the latter into the oil gutterway and thence to the bilges.

Provision is to be made for ventilating the cofferdam or air space, the vents being led to the open air and their outlets being fitted with a wire gauze diaphragm which can easily be removed for renewal.

6. **Fireproof Insulation.**—The insulation in way of coal bunkers and of any surfaces exposed to excessive heat, is to be silicate cotton, or other approved fireproof material, the wood grounds are to be fireproofed and asbestos strips are to be fitted between the wood grounds and the steel work to which they are attached.

Brine leads in bunkers may be packed with granulated cork, but there is to be a thick outer covering of silicate cotton and the whole protected by steel plates.

7. **Watertight Bulkhead Fittings.**—Where cooling pipes pass through watertight bulkheads, or deck plating, the fittings and packing of the stuffing boxes are to be both fireproof and watertight.

8. **Cargo Battens.**—(*a*) Cargo battens are to be provided for the floor or deck and the walls of the chambers previous to loading refrigerated cargoes.

(*b*) Those for the walls of the chambers are to be fastened and should be at least 2 inches × 2 inches, one batten being placed over each frame or ground, the others being intermediately arranged, to suit the class of cargo.

(*c*) The cargo battens for the floors or decks of the chambers are to be fitted to suit the class of cargo.

(*d*) The tunnel top insulation is to be fitted with 3 inch × 3 inch battens.

9. **Thermometer Tubes.**—(*a*) The number and position of the thermometer tubes in the insulated chambers should be submitted for consideration.

(*b*) Thermometer tubes, their flanges and covers are to be insulated from the deck plating and on weather decks they are to be so arranged that water will not run down when taking the temperatures.

(*c*) The inside diameter of thermometer tubes is to be not less than 2 inches and the tubes are to be out of contact with cold decks.

(*d*) Where the thermometer tubes and cooling pipes pass through compartments or chambers other than their respective insulated chambers they are to be efficiently insulated.

10. **Protection of Pipes.**—All pipes, including air and sounding pipes, which pass through or into insulated chambers are to be well insulated in order to prevent the formation of ice inside the pipes.

11. **Draining Arrangements.**—(*a*) Provision is to be made for the continuous drainage of the inside of all insulated chambers and cooler trays. Drains from lower holds to bilges are to be fitted with liquid sealed non-return bilge traps.

Drains from 'tween deck chambers and cooler trays to the hold bilges are to be fitted with liquid sealed traps.

(*b*) Where drains from separate chambers join a common main, the branch pipes are each to be provided with a liquid sealed trap.

(*c*) Sluices, scupper or drain pipes, which would permit drainage from compartments outside the insulated chambers into the bilges of the latter, are not to be fitted.

(*d*) Screwed plugs or other means for blanking off scuppers draining insulated chambers and cooler trays are not to be fitted.

If it is desired to provide means for closing these scuppers, they should be provided with shut-off valves controlled from readily accessible positions on a deck above the load water line.

12. **Sounding Pipes.**—(*a*) Where sounding pipes are fitted in way of insulated chambers their deck connections are to be so arranged that they will be insulated from the deck plating in order to prevent the formation of ice inside the sounding pipes.

(*b*) In the case of insulated holds sounding pipes are to be provided both above and below the insulation. Where the hold temperatures contemplated are lower than 33° F. the sounding pipes are to be not less than 2½ inches bore.

(*c*) Sounding pipes to oil fuel compartments are not to terminate in refrigerated chambers or in fan and battery rooms for refrigerated chambers.

(*d*) Where practicable sounding pipes to oil fuel compartments are not to terminate in enclosed spaces from which access is provided to refrigerated chambers or to fan and battery rooms for refrigerated chambers.

Where these sounding pipes terminate in such spaces these pipes are to be fitted with cocks having parallel plugs with permanently secured handles so loaded that on being released they automatically close the cocks.

13. Brine Cooling Systems.—(*a*) Where the brine system of refrigeration is employed the brine circulating pipes and tanks should not be galvanized on the inside.

(*b*) In cases where internally galvanized tanks or cooling pipes are fitted, the brine cooling and return tanks, if closed, are each to be provided with a ventilating pipe or pipes led to the open air in a situation where no danger will be incurred from the issuing gas, and each ventilating pipe must be fitted with a wire gauze diaphragm which can be easily removed for renewal.

(*c*) Where the tanks are not closed, the compartments in which they are situated must be efficiently ventilated.

(*d*) The brine pipes in each refrigerated chamber are to be arranged in not less than two sections, but particulars of the number and arrangement of sections are to be submitted for consideration. Valves or cocks are to be fitted so that any section can be shut off when necessary.

(*e*) The thickness of the brine pipes at the bottom of the screw threads should not be less than $\frac{3}{32}$ of an inch.

SPARE GEAR.

Section 4. 1. The following spare gear will be required in all cases:—

Lengths and bends of piping of each size used, together with flanges, couplings and screwing apparatus.

Sundry cocks, valves, flanges and fittings.

Assorted bolts, studs and nuts.

A quantity of packings and joint rings.

1 complete set of crank shaft coupling bolts.

1 complete set of motor coupling bolts and washers.

1 compressor piston and rod complete for each size used.

1 set of compressor suction and delivery valves with rings and boxes for each size used.

1 complete set of packing for the compressor piston rod for each size used.

1 gas regulator valve complete.

1 set of valves for water circulating, air and brine pumps for each size used.

In cases where approval is given to alternative arrangements under **Section 2, clause 3**, additional spare gear may be required according to the circumstances of the case.

2. Where steam driven air circulating fans are fitted, the following spare gear will be required:—

For each size used:—

1 crank shaft.

1 steam piston and rod complete.

1 steam cylinder cover.

1 set of connecting rod top and bottom end, and bearing bushes, and bolts complete.

3. Where the refrigerating machinery or its auxiliaries are electrically driven, the following spare gear will be required:—

(*a*) For the generators, motors, control gear and switchboard, a set of spare gear in accordance with **Section 22** of the **Rules for Electrical Equipment.**

(*b*) For electrically driven air circulating fans the following spare gear will be required:—

1 complete fan and motor of each size used.

4. Where the refrigerating machinery is driven direct by oil engines, the proposed spare gear for the engines is to be submitted for consideration.

INSTALLATIONS NOT BUILT UNDER SURVEY.

Section 5.—(*a*) Where a character is required for Refrigerating Installations not surveyed while under construction, application must be made to the Committee in writing. Specifications and drawings showing particulars of machinery and insulation are to be furnished, together with general particulars of the steel used for important steel castings, forgings and refrigerant pressure piping.

(*b*) A special examination is to be made at least to the extent required for Subsequent Special Surveys (**Section 6, clauses 4, 5, 7 and 8**).

(*c*) The thicknesses and material of the insulation particulars of the cooling equipment provided for the chambers, and particulars of the compressors, evaporators and condensers are to be verified.

(*d*) Pressure relief devices, cargo battening arrangements, thermometer tubes and draining arrangements are to be made to conform to the requirements of the Rules.

(*e*) The refrigerating machinery log is to be examined in order to ascertain that the machinery power provided is adequate, and if considered necessary, a cooling test on the installation is to be carried out.

(*f*) Periodical surveys are subsequently to be held as in the case of vessels built under survey.

PERIODICAL SURVEYS.

Section 6. 1. **Incidence of Surveys.** — To entitle vessels to retain the character assigned to the Refrigerating Machinery installation, they are to be subjected to the following periodical surveys:—

(*a*) A **Loading Port Survey,** as detailed in clause 3, is to be held at the loading port every voyage in the case of vessels engaged on voyages of more than two months' duration, but where the voyages are of shorter duration, this survey need only be held at intervals of two months, provided the cargoes carried be of such a nature as not to damage the insulation or appliances in the insulated chambers nor to affect the refrigerated cargoes by taint or mould.

(*b*) A **Complete Survey** as detailed in clause 5 is to be held every twelve months.

(*c*) A **Modified Survey** as detailed in clause 4 is to be held about six months after the Complete Survey.

(*d*) A **Running Survey** as detailed in clause 6 may be held, if desired by the Owners, at intervals of not longer than six months in lieu of the Modified and Complete Surveys.

(*e*) **A Special Survey as detailed in clauses 7 and 8** is to be held upon the occasions of the vessel undergoing the Special Periodical Surveys prescribed in the **Rules for Steel Ships** in the case of vessels classed with this Society, and at intervals of four years in the case of vessels not so classed

2. **Record of Surveys.**—(*a*) The date following the record "Lloyd'sRMC" (*in red*) indicates the date of the last Complete Survey of the refrigerating machinery and appliances, thus:—"Lloyd'sRMC3,45" (*in red*).

(*b*) The date under the record "Lloyd's RMC" (*in red*) indicates the date of the last Modified Survey of the refrigerating machinery and appliances, thus:—"Lloyd'sRMC3,45 / 9,45" (*in red*).

(*c*) Where Running Surveys are held in lieu of the Modified and Complete Surveys, this will be indicated by the record "Lloyd'sRMC (RS)" (with date) (*in red*), the date being that of the last examination in accordance with clause 6.

(*d*) The date of the last Special Survey in accordance with clauses 7 and 8 will be recorded under the name of the vessel, thus:—"SRMC3,45" (*in red*).

(*e*) Where, in any case, only part of the requisite examination is held, the certificate will be endorsed with the statement of what is required to complete the survey.

3. **Loading Port Survey.**—(*a*) The chambers are to be examined to ascertain that they are clean and free from odour, that the brine pipes are free from leakage, that the cargo battens are in good order and that no damage has been sustained to the insulation prior to the loading of the refrigerated cargo.

(*b*) The chambers should be examined under frosted conditions and any indications of deficient insulation not considered to warrant immediate attention should be noted and specially reported.

(*c*) The Surveyor is to satisfy himself that all scuppers and bilge suctions draining insulated spaces are in good working order.

(*d*) The refrigerating machinery is to be tested under working conditions, the temperatures in the chambers being noted.

(*e*) If the vessel loads at more than one port, one survey only at a loading port will be required, provided it includes the examination of all the chambers, and general cargo is not subsequently carried in the refrigerated chambers prior to loading refrigerated cargo.

(*f*) If there is not a Surveyor to the Society available at the loading ports, or if there is not one obtainable from a port within a reasonable distance, the Committee will accept the report of a survey held at the loading port by a Surveyor appointed by Lloyd's agent; or (in any case where there is no Lloyd's agent) the report of a survey held by a reliable Surveyor, if available; or (if no such Surveyor is available) a report signed by two competent Engineers of the vessel.

4. **Modified Survey.**—(*a*) The machinery is to be examined under working conditions on the vessel's arrival at the port of discharge, before the refrigerated cargo is fully discharged.

(*b*) The refrigerating machinery log is to be examined in order to ascertain that the machinery has been operating satisfactorily during the voyage with refrigerated cargo.

(*c*) The compressor cylinders and valves are to be examined; the piston and piston rod need not be withdrawn for examination unless considered necessary by the Surveyors.

(*d*) Where the refrigerating machinery or its auxiliaries are electrically driven, a general examination of all the generators, motors and their control gear, and cables, is to be made and the insulation

resistance measured. The insulation resistance is to be not less than 100,000 ohms, and for the purpose of this test each item may be taken separately. Where an Owner employs a competent and reliable staff or electrical contractor, Surveyors may consult their records and at their discretion accept megger tests carried out by them.

(*e*) The spare gear is to be examined.

(*f*) The gas and liquid pipes, separators, receivers, condenser and evaporator coil terminals are to be examined externally as far as practicable.

(*g*) The brine pipes are to be examined.

(*h*) Direct expansion pipes are to be examined under full working conditions.

(*i*) The insulation throughout the cargo chambers is to be carefully examined. Where silicate cotton, granulated cork or similar media are employed for insulating purposes, the insulation is to be examined for fullness and dryness by boring where necessary. The test holes are to be efficiently closed. Special attention is to be paid to the insulation under trunks and hatches where dampness may accumulate, to the sides under stringers and under decks, and to the tunnel tops. All bilge and manhole plug hatches are to be removed, the bilges cleared and the suction pipes, suction roses and sounding pipes are to be examined. Hatches, air trunkways and thermometer tubes, with their connections and fastenings, are to be examined.

(*j*) The Surveyor is to satisfy himself that all scuppers draining insulated spaces are in good working order.

5. **Complete Survey.**—(*a*) All the requirements of clause 4 (Modified Survey) are to be complied with.

(*b*) The compressor crank shafts, connecting rods, bearings, pistons and piston rods are to be examined.

(*c*) Where the refrigerating machinery is driven by steam or internal combustion engines, the cylinders, pistons, valves, crank shafts, connecting rods and bearings are to be examined.

(*d*) Where the refrigerating machinery is electrically driven, one of the engines or turbines driving the generators is to be opened up and examined completely in regular rotation.

(*e*) The working parts of the water and brine circulating pumps are to be examined.

(*f*) Where other auxiliary machinery is fitted, the working parts are to be examined.

(*g*) The brine pipes are to be tested to 1½ times the working pressure, or 40 lb. per square inch, whichever is the greater.

6. **Running Survey.**—(*a*) All the requirements of clause 4 (Modified Survey), except paragraph (*c*), are to be complied with.

(*b*) The compressor cylinders, valves, crank shaft, connecting rods, bearings, pistons and piston rods of one or more machines are to be examined at each survey in regular rotation, so that all machines are examined within a period of twelve months.

(*c*) Where the refrigerating machinery is driven by steam or internal combustion engines, the cylinders, pistons, valves, crank shaft, connecting rods and bearings of one or more engines, are to be examined at each survey in regular rotation, so that all the driving engines are examined within a period of twelve months.

(*d*) Where the refrigerating machinery is electrically driven, one of the engines or turbines driving the generators is to be opened up and examined completely at intervals of not more than twelve months, in regular rotation.

(*e*) The working parts of one or more brine pumps and one or more circulating pumps are to be examined at each survey in regular rotation, so that all the pumps are examined within a period of twelve months.

(*f*) Where other auxiliary machinery is fitted, the working parts are to be examined.

(*g*) The brine pipes are to be tested to 1½ times the working pressure, or 40 lb. per square inch, whichever is the greater, at intervals of not more than twelve months.

(*h*) A Survey Book is to be kept on board the vessel to show the date of examination of the various parts, and is to be signed by the Surveyor on the occasion of each survey.

7. **First Special Survey.**—(*a*) All the requirements of clause 5 (Complete Survey) are to be complied with except where the surveys are being held in accordance with clause 1 (*d*), when the requirements of clause 6 (Running Survey) are to be complied with.

(*b*) Where the refrigerating machinery or the generators supplying the refrigerating machinery are driven by steam engines, the air and feed pumps, steam pipes and steam condenser are to be examined, and, if necessary, the steam condenser is to be tested.

(*c*) Where the refrigerating machinery is driven by internal combustion engines, the cylinders, pistons, valves, crank shafts, piston and connecting rods and bearings of the air compressors are to be examined. The air receivers and air pressure pipes are to be cleaned internally. The air receivers are to be examined internally and in cases where the construction of the receivers is such that a proper internal examination cannot be made, they are to be tested by hydraulic pressure to $1\frac{1}{2}$ times the working pressure.

(*d*) Sufficient insulation is to be stripped from groups of brine pipe leads, or brine mains, in bunkers or near boilers or where buried in hold insulation to permit of the condition of the pipes being ascertained.

(*e*) Sufficient air trunking or baffle boarding is to be stripped to permit of the condition of the insulation and lining being ascertained.

(*f*) Sufficient tank top insulation is to be stripped to permit of the condition of the grounds and inner insulation lining being ascertained.

(*g*) Sea injection valves are to be opened up and examined.

(*h*) All thermometers used for measuring chamber and air suction and delivery temperatures are to be checked.

71, Fenchurch Street, London, E.C.3.
17th October, 1946.

8. **Subsequent Special Surveys.**—(*a*) All the requirements of clause 7 (First Special Survey) are to be complied with.

(*b*) The coils of gas condensers and evaporators of the shell and coil type are to be drawn for examination and tested to a pressure of 300 lb. per square inch for Methyl Chloride or Freon systems, 1,000 lb. per square inch for Ammonia systems and 2,500 lb. per square inch for Carbon Dioxide systems.

(*c*) Gas condensers and evaporators of the shell and tube type are to have the water or brine end covers removed, and are to be tested to a pressure of 300 lb. per square inch for Methyl Chloride or Freon systems, and 400 lb. per square inch for Ammonia systems.

(*d*) Direct expansion grids or batteries are to be tested in place to a pressure of 100 lb. per square inch for Methyl Chloride or Freon systems, and 150 lb. per square inch for Ammonia systems.

9. **Survey of Repairs.**—Where any essential repairs or renewals are effected to the refrigerating machinery or insulation, these must be carried out under the inspection, and to the satisfaction, of the Society's Surveyors. Repairs and renewals effected at ports where there is no Surveyor to this Society must be surveyed by one of the Society's Surveyors at the earliest opportunity.

QUALITY AND TESTING OF MATERIALS.

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QUALITY AND TESTING OF MATERIALS.

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RULES FOR QUALITY AND TESTING OF MATERIALS.

QUALITY AND TESTING OF SHIP STEEL AND BOILER MATERIAL.

Steel Plates, Bars and Angles.

Section 1. 1. **General Regulations.** — The steel used in the construction of vessels or boilers intended for vessels classed, or proposed for classification, in the Society's Register Book, is to comply with the tests described hereafter.

2. **Process of Manufacture.**—The steel is to be made by the Open Hearth process, Acid or Basic.

3. **Freedom from Defects.**—The finished material is to be free from cracks, surface flaws, and lamination. It is also to have a workmanlike finish, and must not have been hammer-dressed.

4. **Testing and Inspection.**—(*a*) The prescribed tests and inspections are to be made at the place of manufacture prior to despatch ; but, in the event of any of the material proving unsatisfactory in the course of being worked into vessels or into boilers, such material shall be rejected, notwithstanding any previous certificate of satisfactory testing, and such further tests of the material from the same charge may be made as the Surveyor may consider desirable.

(*b*) All test pieces are to be selected by the Surveyor and tested in his presence, and he is to satisfy himself that the prescribed conditions are fulfilled.

5. **Additional Tests before Rejection.**—(*a*) Where any of the test pieces first selected by the Surveyor do not fulfil the test requirements, two further tests of the same kind may be made from the same plate or bar, but where either of these fail, the plate or bar from which the test pieces were cut is to be rejected. In all such cases further tests are to be made before any material from the same charge can be accepted.

(*b*) Where a tensile test piece breaks outside the middle half of its gauge length, and the elongation is less than that required by the Rules, the test may, at the Maker's option, be discarded and another test be made of the same plate or bar.

6. **Branding.**—(*a*) Every plate and bar is to be clearly and distinctly marked by the Maker in two places with the Society's brand, thus :—  indicating that the material has complied with the Society's tests.

(*b*) Plates or bars bearing this brand are not to be forwarded from the Steel Works until the prescribed tests have been made by the Surveyor, and the mill sheets have been signed by him. All plates and bars are also to be legibly stamped in two places with the Maker's name or trade mark, and the place where made. They are also to be stamped with numbers or identification marks by which they can be traced to the charge from which the material was made.

7. **Defacing of Rejected Material.**—In the event of the material failing, in any case, to withstand the prescribed tests, the Surveyor is to see that the Society's brand stamped on the plates and bars by the Maker has been defaced by punch marks extending beyond the brand in the form of a cross, thus :—  denoting that the material has been rejected.

8. **Maker's Certificate.**—Before the mill sheets are signed by the Surveyor, the Maker is required to furnish him with a certificate guaranteeing that the material has been made by the Open Hearth process, and that it has been subjected to, and has withstood satisfactorily, the required tests in the presence of the Surveyor. The following form of certificate will be accepted if printed on each mill sheet with the name of the firm, and initialled by the Test House Manager :—

> "We hereby certify that the material described below has been made by the Open Hearth process, and is that which has been satisfactorily tested in the presence of the Surveyor in accordance with the Rules of Lloyd's Register."

9. **Facilities for Inspection.**—The Maker is to adopt a system of marking the ingots, billets, slabs, plates, bars, and other material which will enable all finished material to be traced to the original charge, and the Surveyor must be given every facility for tracing all plates and bars to their

respective charges, and for witnessing the required tests. When the Surveyor is satisfied with the material and with the results of the tests, he is to be furnished with two copies of the advice notes of the material for his signature, one of which is to be forwarded by the Manufacturer to the Shipbuilder or Boiler Maker, and the other is to be forwarded by the Surveyor to the Surveyors at the port where the vessel or boiler is to be built.

10. **Steel not produced where Rolled.**—Where steel is not produced in the works at which it is rolled, a certificate is to be supplied to the Surveyor, stating the Open Hearth process by which it was made, the name of the Steel Maker who supplied it, also the numbers of the charges for reference to the books of the Steel Maker. The number of the charge is to be marked on each ingot or billet for the purpose of identification, and the finished plates and bars are also to be legibly stamped in two places with the Maker's name or trade mark, and the place where made. They are also to be stamped with numbers or identification marks by which they can be traced to the charge from which the material was made.

11. **General.**—In addition to the tests described hereafter the material may be subjected to further tests at the discretion of the Surveyors.

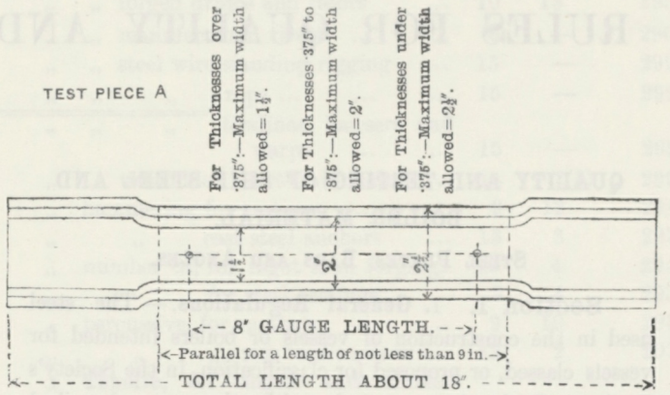
12. **Steel of other Tenacity.**—When desired by Owners and Builders, consideration will be given by the Committee to proposals for the use of steel of other tenacity than is provided for in the Rules.

STANDARD TEST PIECES.

Section 2. 1. **Tensile Test Pieces.**—The tensile strength and ductility are to be determined from Standard test pieces cut lengthwise or crosswise from the rolled material. Where material is annealed or otherwise treated before despatch, the test pieces are to be similarly and simultaneously treated with the material before testing.

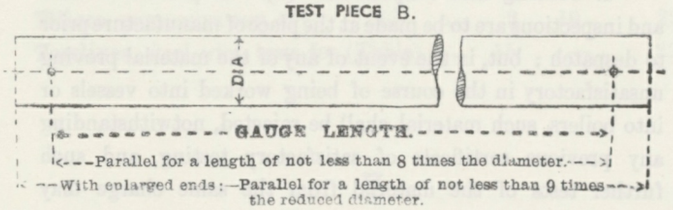
2. **Plates.**—(*a*) Wherever practicable the rolled surfaces are to be retained on two opposite sides of the test piece. The elongation is to be measured on a Standard test piece having a gauge length of 8 inches.

(*b*) For material more than ·875 inch in thickness the width of the test piece between the gauge points is not to exceed 1½ inches; or material ·875 inch to ·375 inch in thickness, inclusive, the width is not to exceed 2 inches; for material less than ·375 inch in thickness the width is not to be more than 2½ inches. In other respects the test pieces are to conform generally to the Standard test piece A.

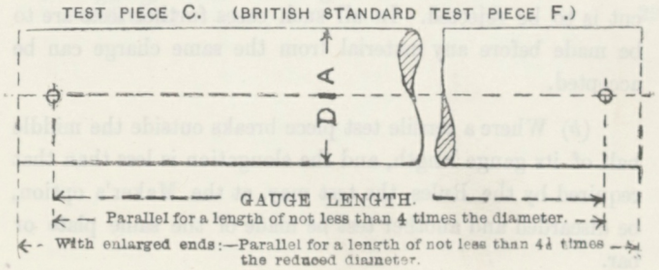


3. **Round Bars.**—(*a*) Bars may be tested full size as rolled, or they may be turned down to a convenient size, and if tested one inch in diameter, or under, the test piece is to have a gauge length of 8 times the diameter. Where enlarged ends are used the length of the parallel portion is not to be less than 9 times the reduced diameter of the test piece (*see* Standard test piece B).

The sectional area of the test piece is not to be less than ¼ square inch.



(*b*) Where bars are above one inch diameter, and are tested full size as rolled, or have been turned down and the resulting test piece is above one inch diameter, a gauge length of 4 times the diameter may be used if preferred by the Manufacturer, in which case an increased elongation will be required, as specified in Sections 5 and 6. Where enlarged ends are used, the length of the parallel portion is not to be less than 4½ times the reduced diameter (*see* Standard test piece C).



4. **Straightening of Test Pieces.**—Any straightening of test pieces A, B and C which may be required is to be done cold.

BEND TEST PIECES AND TESTS FOR SHIP AND BOILER STEEL.

Section 3. 1. **Number of Bend Tests for Ship Steel.**—A bend test is to be taken from each plate as rolled.

One bend test is to be made from each type of section and from each diameter of bar in every batch of 5 tons or part of 5 tons rolled from the same charge with a minimum of two bend tests per batch.

2. **Number of Bend Tests for Boiler Steel.** (*a*) **Plates.**—A bend test piece is to be taken from each plate as rolled. For plates exceeding $2\frac{1}{2}$ tons in weight one bend test piece is to be taken from each end.

(*b*) **Angle Bars.**—A bend test is to be taken from from each angle bar rolled.

(*c*) **Stay Bars.**—A bend test is to be made where a tensile test is required.

3. **Bend Test Pieces.**—(*a*) Test pieces are to be sheared lengthwise or crosswise from plates or bars, and are not to be less than $1\frac{1}{2}$ inches wide, but for small bars the whole section may be used. For rivet bars bend tests are not required.

(*b*) In all bend tests, the rough edge or arris caused by shearing may be removed by filing or grinding, and test pieces one inch in thickness and above may have the edges machined, but the test pieces are to receive no other preparation. The test pieces are not to be annealed or otherwise heat treated unless the material from which they are cut is similarly heat treated, in which case the test pieces are to be similarly and simultaneously treated with the material before testing.

(*c*) For small sectional material these bend tests may be made from the flattened bar.

4. **Bend Tests.**—(*a*) The test piece is to withstand, without fracture, being doubled over until the internal radius is equal to $1\frac{1}{2}$ times the thickness of the test piece, and the sides are parallel.

(*b*) Bend tests may be made either by pressure or by blows.

TESTS FOR SHIP STEEL.

Section 4. 1. **Number of Tensile Tests. Plates and Sectional Material.**—When the Surveyor is in constant attendance at the Steel Works one tensile test piece for plates or sectional material is to be taken from the finished material of each charge.

Where the quantity of the material from one charge exceeds 25 tons, a second tensile test will be required; also additional tests are to be made for every variation in thickness of ·15 of an inch in the plates or sectional bars from each charge.

2. **Tensile Tests.** (*a*) **Plates.**—The tensile breaking strength of steel plates, determined from Standard test pieces, is to be between the limits of 26 and 32 tons per square inch. For plates specially intended for cold flanging and marked for identification, the tensile strength is to be between the limits of 26 and 30 tons per square inch. In the case of material for purposes in which tensile strength is not important, the tensile test may be dispensed with and the bend test only be made, if so specified by the builders and approved by the Committee. The elongation, measured on a Standard test piece having a gauge length of 8 inches, is not to be less than 20 per cent for material of ·375 inch in thickness and upwards, and not less than 16 per cent for material below ·375 inch in thickness.

(*b*) **Angles, Bulb Angles, Channels, and Similar Sections.**—The tensile breaking strength of angles, bulb angles, channels, and similar sectional material is to be between the limits of 26 and 32 tons per square inch. In the case of material for purposes in which tensile strength is not important, the tensile test may be dispensed with and the bend test only be made, if so specified by the builders and approved by the Committee. The elongation measured on a Standard test piece having a gauge length of 8 inches is not to be less than 20 per cent for material of ·375 inch in thickness and upwards, and not less than 16 per cent for material below ·375 inch in thickness.

3. **Occasional Attendance at Steel Works (Steel for Shipbuilding Purposes).**—(*a*) When the Society's Surveyor is not in constant attendance at the Steel Works, the Makers themselves may, with the written authority of the Society, comply with all the prescribed requirements, and furnish the Surveyor with a certificate to the effect that the Society's Rules as to the testing of steel have been complied with in the case of the material submitted for approval.

The Surveyor is then to make check tensile and cold bend tests from not less than one bar in every batch of 50 or less in number, or not less than one plate in each batch of 25 or less in number, provided the batch be all from one charge.

Where more than one charge is represented, each charge is to be tested.

Additional tests are also to be made for every variation in thickness of ·15 of an inch made from one charge.

The test pieces are not to be taken from shearings previously detached from the plates or bars but are to be selected by the Surveyors from the plates or bars themselves, either in the sheared or unsheared condition. Should part of the material be presented in a sheared condition the selection of tests is not to be confined to the unsheared portion.

The samples when marked by the Surveyor for testing are to be followed, as far as practicable, through the different stages of preparation until the tests are completed.

A tensile and a cold bend test are to be taken crosswise from the centre part of the selected plate or plates at each end.

In addition to the tests prescribed above the material may be subjected to further tests at the discretion of the Surveyor.

(*b*) Where the tests are unsatisfactory, the whole of the material from the charge is to be rejected, and the Surveyor is to see that the Society's brand is satisfactorily defaced.

TESTS FOR STEEL FOR RIVETED BOILERS AND WELDED PRESSURE VESSELS.

Section 5. 1. All plates intended for cylindrical shells of pressure vessels which are to be welded, or where the thickness exceeds $1\frac{3}{4}$ inches, or where the internal diameters of the vessels are less than 100 times the thickness of the plates, should be efficiently normalised before the test pieces are cut off.

2. **Number of Tensile Tests.** (*a*) **Plates.**—One tensile test piece is to be taken from each plate as rolled. For plates exceeding $2\frac{1}{2}$ tons in weight one tensile test piece is to be taken from each end.

(*b*) **Angle, Tee and Stay Bars.**—One tensile test is to be made from each 15 or part of 15 bars rolled of each section or diameter from the same charge, but not less than two tensile tests are to be made unless the total number of bars rolled from the same charge is 8 or less than 8 and the bars are of the same section or diameter, in which case one tensile test will suffice. For round bars of $1\frac{3}{4}$ inch diameter and under, the numbers 50 and 20 are to be substituted for 15 and 8 respectively for determining the number of tests required.

3. **Tensile Tests.** (*a*) **Plates.**—The tensile breaking strength of steel shell plates, determined from Standard test pieces, is to be between the limits of 28 and 35 tons per quare inch for riveted boilers, 26 and 35 tons per square nch for Fusion Welded Pressure Vessels and 26 and 30 tons per square inch for Forge Welded Pressure Vessels. *See* **clause 3** (*d*).

For girder plates the tensile breaking strength is to be between the limits of 28 and 35 tons per square inch.

For plates intended for flanging and for combustion chambers and furnaces, also for plates, other than shell plates, which are to be welded, the tensile breaking strength is to be between the limits of 26 and 30 tons per square inch.

A range of more than 4 tons per square inch will not be permitted in any one case. The elongation, measured on a Standard test piece having a gauge length of 8 inches, is not to be less than 20 per cent for material of ·375 inch in thickness and upwards required to have a tensile breaking strength between the limits of 28 and 35 tons per square inch ; and not less than 23 per cent for material of ·375 inch in thickness and upwards required to have a tensile breaking strength between the limits of 26 and 30 tons per square inch.

(*b*) **Angle and Tee Bars.**—The tensile breaking strength of angle and tee bars is to be between the limits of 28 and 32 tons per square inch, with an elongation of not less than 20 per cent measured on the Standard test piece A.

For plates, angles, or tee bars under ·375 inch in thickness the elongation may be 3 per cent, but not more than 3 per cent, below the prescribed elongations.

Wherever practicable the rolled surfaces are to be detained on two opposite sides of the test pieces.

(*c*) **Stay Bars.**—The tensile breaking strength of longitudinal stay bars is to be between the limits of 28 and 35 tons per square inch, with an elongation of not less than 20 per cent measured on the Standard test piece B, or 24 per cent measured on the Standard test piece C ; but a range of not more than 4 tons per square inch shall be permitted in any one case. For steel bars for combustion chamber stays the tensile breaking strength is to be between the limits of 26 and 30 tons per square inch, with an elongation of not less than 23 per cent measured on the Standard test piece B or 28 per cent measured on the Standard test piece C.

(*d*) **Special Quality Steel for Boilers.**—When steel material is proposed having other tensile strength than that specified in this Section, the proposed limits of tensile strength and elongation should be submitted for consideration.

In the case of forge welded cylindrical shells, material having tensile breaking strength between the limits of 24 and 28 tons per square inch, and elongation not less than 25 per cent on a gauge length of 8 inches will be accepted, the test pieces being taken crosswise from the plates as rolled.

TESTS FOR RIVET BARS AND MANUFACTURED RIVETS.

Section 6. 1. **Testing of Material.**—All material from which rivets are manufactured is to be tested.

Rivets are not to be manufactured from steel or ingot iron bars in which the sulphur segregates and other non-metallic substances are concentrated in the core. To ensure this, a sulphur print is to be taken from the material of each charge, and where the weight of bars as rolled from one charge exceeds 10 tons, additional sulphur prints may be taken.

2. **Number of Tests.**—(*a*) In the case of steel bars, one tensile test piece is to be taken from each charge used for rivet bars ; but where the weight of bars as rolled from one charge exceeds 10 tons, an additional tensile test is to be made from each further 10 tons or portion thereof.

(*b*) In the case of wrought iron bars, two tensile tests shall be taken from every three tons or portion thereof in each batch of any order presented for inspection, except that, in the case of lots of one ton or less, one tensile test shall be accepted.

(*c*) In the case of ingot iron bars, one tensile test piece is to be taken from each charge used for rivet bars ; but where the weight of bars as rolled from one charge exceeds 10 tons, an additional tensile test is to be made from each further 10 tons or portion thereof.

(*d*) For rivet bars of steel or ingot iron one dump test is to be made for each tensile test.

3. **Tensile Tests.**—(*a*) The tensile breaking strength of steel rivet bars is to be between the limits of 26 and 30 tons per square inch of section with an elongation of not less than 25 per cent of the gauge length of eight times the diameter of the test piece, measured on the standard test piece B, or 30 per cent measured on the standard test piece C. The bars may be tested the full size as rolled.

(*b*) The tensile breaking strength of wrought iron rivet bars is to be between the limits of 21 and 25 tons per square inch. The elongation is to be not less than 22 per cent of the gauge length of eight times the diameter of the test piece, measured on the standard test piece B.

(*c*) The tensile breaking strength of ingot iron rivet bars is to be between the limits of 21 and 25 tons per square inch, with an elongation of not less than 25 per cent of the gauge length of eight times the diameter of the test piece, measured on the standard test piece B, or 30 per cent measured on the standard test piece C. The bars may be tested the full size as rolled.

4. **Dump Test.**—Short lengths, equal to twice their diameter, cut from the rivet bars shall, when cold, withstand without fracture being compressed to half their length.

5. **Nicked Bend Tests.**—(*a*) In the case of wrought iron bars one nicked bend test shall be taken from each three tons of material or portion thereof in each batch of any order presented for inspection.

(*b*) The test pieces shall be lightly and evenly nicked on one side with a sharp cutting tool, and bent back at this point through an angle of 180°. They shall show a clean fibrous fracture, free from slag or dirt or any coarse crystalline structure.

6. **Manufactured Rivets.**—Rivets selected by the Surveyor from the bulk are to withstand the tests described hereafter.

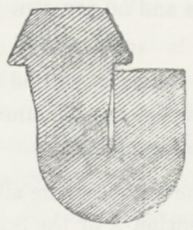


FIG. 1.

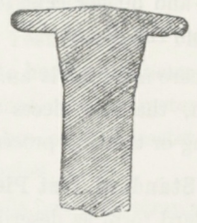


FIG. 2.

(*a*) The rivet shanks are to be bent cold, and hammered until the two parts of the shank touch in the manner shown in Fig. 1, without fracture on the outside of the bend.

(*b*) The rivet heads are to be flattened, while hot, in the manner shown in Fig. 2, without cracking at the edges. The heads are to be flattened until their diameter is $2\frac{1}{2}$ times the diameter of the shank.

(*c*) In the case of steel or ingot iron rivets, samples are to be selected by the Surveyor for examination by means of sulphur prints, to ensure that the material is free from marked central segregation.

SPECIAL QUALITY STEEL FOR SHIPBUILDING.

Regulations for Testing.

Section 7. 1. **Process of Manufacture.**—The steel is to be made by the Open Hearth Process, Acid or Basic, at works recognised by the Committee.

2. **Freedom from Defects.**—The finished material is to be free from cracks, surface flaws and laminations. It is also to have a workmanlike finish, and must not be hammer dressed.

3. **Testing and Inspection.**—The prescribed tests and inspections are to be made at the place of manufacture from the plates or bars in the condition in which they will be despatched ; in the event of any of the material proving unsatisfactory in the course of being worked into the vessels, such material shall be rejected, notwithstanding any previous certificate of satisfactory testing, and such further tests of the material from the same charge may be made as the Surveyor may consider desirable.

All test pieces are to be selected by the Surveyor and tested in his presence, and he is to satisfy himself that the prescribed conditions are fulfilled.

4. **Tensile Test Pieces.**—The tensile strength, ductility and limit of proportionality (as defined below) are to be determined from standard test pieces cut lengthways from the bar, and 50 per cent lengthways and 50 per cent crossways from the plate.

Where material is annealed or otherwise treated before despatch, the test pieces are not to be cut off until the annealing or treating process has been completed.

5. **Standard Test Pieces.**—The test pieces are all to be of standard form as described in **Section 2** of the Society's **Rules for the Quality and Testing of Materials.**

6. **Tensile Strength.**—The tensile breaking strength is not to exceed 38 tons per square inch, with a range of not more than 5 tons per square inch in any one case; the elongation is to be not less than 20 per cent measured on a gauge length of 8 inches.

7. **Limit of Proportionality.**—The material must satisfy a test for limit of proportionality of not less than 15 tons per square inch, the elastic properties being determined by means of a Ewing extensometer, or other approved extensometer, of 8 inch gauge length. The tests shall be carried out as follows:—

(*a*) A load of 2 tons per square inch of section shall be applied to the test piece and an extensometer reading taken.

(*b*) The load shall be increased to 15 tons per square inch of section and a second reading taken.

(*c*) The load shall be reduced to 2 tons per square inch and a third reading taken.

(*d*) The third reading shall not exceed the first reading by more than ·0004 inches.

8. **Number of Test Pieces.**—One tensile test piece is to be made from at least every fifth plate or bar, as rolled, from each charge. This test piece is to be used for determining both the limit of proportionality and the tensile strength. The Surveyor should select a sample from each variation of thickness of ·10 of an inch in the plates or bars from each charge.

9. **Cold Bend Tests.**—A cold bend test is to be taken both lengthways and crossways from every plate (bars lengthways only). The test pieces are to withstand without fracture, being doubled over until the internal radius is equal to one and a half times the thickness of the test pieces and the sides are parallel.

10. **Preparation of Test Pieces.**—The test pieces are to be carefully prepared in the usual manner.

11. **Additional Tests before Rejection.**—Where any of the test pieces first selected by the Surveyor do not fulfil the above requirements, two further tests of the same kind may be made from the same plate or bar, but where either of these fail the plate or bar from which the test pieces were cut is to be rejected.

In addition to the tests described above, the material may be subjected to further tests at the discretion of the Surveyor.

12. **Branding.**—In addition to the Manufacturer's name or Trade Mark and the place where made, and the numbers and identification marks laid down by the Society's Rules, each plate or bar is to be distinctly branded in two places with the Society's brand LR. and, in addition, with letters SPL, thus:—LR. SPL. in one stamp.

13. **Defacing of Material.**—In the event of the material failing, the brand is to be defaced in the usual manner.

14. **Submission of Plans.**—When it is desired to use this material in the construction of vessels intended to be classed in the Society's Register Book, plans showing the reduction of scantlings proposed should be submitted for the consideration of the Committee.

15. **Alternative Proposals.**—The Committee will consider proposals for the use of special quality steel having limits different from those prescribed above, provided full particulars as to the properties and manufacture of the material are submitted for consideration.

SPECIAL IRON FOR SCREW STAYS FOR COMBUSTION CHAMBERS.

Section 8. General.—In order that iron screw stays may be approved of the same size as would be required for mild steel the iron must withstand the tests described hereafter.

1. **Number of Tensile Tests.**—The bars as rolled are to be placed in batches of 20, and one tensile test piece is to be taken from each batch. If this is unsatisfactory, two other bars are to be selected for test, but should either of these fail the batch is to be rejected.

2. **Tensile Test.**—The tensile breaking strength is not to be less than 21½ tons per square inch, with an elongation of not less than 25 per cent measured on the Standard test piece B, or of 30 per cent measured on the Standard test piece C.

3. **Bend Tests.**—(*a*) Test pieces, either of the bar as rolled or turned down to one inch diameter, are to stand bending cold until the sides are parallel and the space between the two sides is not greater than the diameter of the test piece.

(*b*) One ordinary bend test piece is to be taken from each batch, and a similar test piece from each batch is to be lightly and evenly nicked on one side with a sharp cutting tool and bent back at this point through an angle of 180° by pressure or by a succession of light blows. The fracture must be clean, fibrous, free from slag or dirt or any coarse crystalline structure. If either of these tests is unsatisfactory, two other bars are to be selected for test, but should either of these fail the batch is to be rejected.

QUALITY AND TESTING OF STEEL CASTINGS.

Section 9. 1. **Process of Manufacture.**—Steel for castings is to be made by the Open Hearth process, Acid or Basic, or by such other process as may be approved by the Committee.

2. **Heat Treatment.**—All steel castings are to be thoroughly heat treated in a properly constructed furnace, which must permit of the whole casting being uniformly raised in temperature throughout its whole extent to the necessary intensity. The casting is to be allowed to cool prior to removal from the furnace, and if afterwards heated for any purpose it is again to be similarly heat treated if required by the Surveyor.

3. **Testing and Inspection.**—(*a*) The tests and inspections hereafter described are to be made, preferably at the place of manufacture prior to despatch, but in the event of any casting proving unsatisfactory in the course of preparation or erection, such casting is to be rejected notwithstanding any previous certificate of satisfactory testing.

(*b*) The tensile strength and ductility are to be determined from standard test pieces, which are to be prepared from pieces cast on the casting. These pieces are not to be cut or partially cut from the castings until the heat treatment of such castings has been completed, nor until they have been stamped by the Surveyor. The test pieces are to be stamped by the Surveyor after the heat treatment. All test pieces are to be selected by the Surveyor and tested in his presence, and he is to satisfy himself that the conditions herein described are fulfilled.

(*c*) Where the castings are to be used for purposes for which cast iron is ordinarily employed they need not be submitted to tensile and bend tests, but they are to be submitted to the hammering tests specified in **clause 12.**

4. **Number of Tests.**—At least one tensile test and one cold bend test are to be taken from each casting. In castings of complex design, referred to in **clause 11**, at least two tensile and two cold bend tests are to be taken. Where a casting is made from more than one charge of steel, at least four tensile and four cold bend tests are to be taken from pieces cast as far apart as possible on the casting, some test pieces being taken from as near the top, and others from as near the bottom of the casting as practicable

5. **Dimensions of Tensile Test Pieces.**—The tensile test pieces are to be turned so as to have a diameter of ·564 inch with a gauge length of 2 inches, or a diameter of ·798 inch with a gauge length of 3 inches, or a diameter of ·977 inch with a gauge length of $3\frac{1}{2}$ inches.

6. **Tensile Tests.**—The tensile breaking strength determined from test pieces of Standard dimensions is to be between the limits of 26 and 35 tons per square inch with an elongation of not less than 20 per cent measured on the Standard test piece.

7. **Dimensions of Bend Test Pieces.**—The bend test pieces are to be machined to a rectangular section one inch wide by $\frac{3}{4}$ inch thick, with the edges rounded to a radius of $\frac{1}{16}$th of an inch. They are to be bent over the thinner section. The bending may be performed either by pressure or by blows.

8. **Bend Tests.**—The bend test pieces are to withstand, without fracture, being bent cold through an angle of 120 degrees, the internal radius of the bend being not greater than one inch.

9. **Additional Tests before Rejection.**—Where either the tensile or bend test or both fail, and the Surveyor considers the fractured test piece or test pieces, or the results obtained therefrom, do not fairly represent the quality of the casting, duplicates of the test or tests which failed are to be made if requested by the Maker. In such cases the quality of the casting is to be judged by the result of the duplicate test or tests and not by the original test or tests which failed.

10. **Percussive Tests.**—Stern frames cast in one piece are to be let fall on hard ground (excavations being made to take bosses and other projections) after being raised through an angle of 45 degrees. Stern frames cast in more than one piece, rudders, steering quadrants, crossheads and tillers, are to be dropped on hard ground from a height of from 7 to 10 feet according to the design, shape, and weight of the casting.

11. **Castings of Complex Design.**—Castings of complex design which would be liable to be deformed if submitted to the drop or percussive test, may have this test dispensed with provided two tensile and two cold bend tests are made upon pieces taken from positions as far apart as possible on each casting; one tensile and one bend test being taken from as near the top and the others from as near the bottom of the casting as practicable.

12. **Hammering Tests.**—All castings are to be slung up and well hammered to satisfy the Surveyors that the casting is sound and without flaw. For large castings the hammer used for this test is to be not less than 7 lb. weight. In the case of castings which are subjected to the percussive tests mentioned in **clause 10**, the hammering tests are to be applied after the percussive tests.

13. **Drilling Tests.**—In the case of large steel castings the Surveyors are to supplement the foregoing tests by drilling small holes at such parts of the castings where experience shows that cavities and contraction cracks are most likely to occur, and at positions which are to be agreed upon between the Surveyor and the Manufacturer, in order to determine the soundness or otherwise of the casting. These holes are afterwards to be tapped and properly filled up with screw plugs.

14. **Branding.**—Every casting, after it has withstood satisfactorily the prescribed tests, is to be clearly and distinctly marked by the Society's Surveyor indicating that the casting has complied with the Society's requirements.

QUALITY AND TESTING OF INGOT STEEL FORGINGS.

Section 10. 1. **Process of Manufacture.**—(*a*) Ingot steel for forgings is to be made by the Open Hearth process, Acid or Basic, or by such other process as may be approved by the Committee.

(*b*) The forgings are to be sound; they are to be made from sound ingots, and for all important forgings such as stern frames, rudder heads and main pieces of rudders upon which arms are shrunk, crank and other shafts connecting rods and piston rods, the forgings are to be gradually and uniformly forged. The sectional area of the body of the forging (as forged) is not to exceed one-fifth of the sectional area of the original ingot, and no part of the forging (as forged) is to have more than two-thirds of the sectional area of the original ingot.

(*c*) Where ingots are cast in chilled moulds with the larger diameter or cross section uppermost, and with efficient refractory feeder heads, the sectional area of any part of the forging (as forged) is not to exceed:—

(1) One-third of the sectional area of the ingot where the length of any diameter is greater than its diameter.

(2) Two-thirds of the sectional area of the ingot where the length at any diameter is less than its diameter, e.g., "a collar."

2. **Heat Treatment.** — All important ingot steel forgings are to be suitably heat treated in a properly constructed furnace, which must permit of the whole forging being uniformly raised in temperature throughout its whole extent, to the necessary intensity. If the forging be subsequently heated for any further forging, it is again to be similarly heat treated, if required by the Surveyors.

3. **Testing and Inspection.**—(*a*) The tests and inspections hereafter described are to be made, preferably at the place of manufacture prior to despatch, but in the event of any forging proving unsatisfactory in the course of preparation or erection, such forging is to be rejected notwithstanding any previous certificate of satisfactory testing.

(*b*) The tensile strength and ductility are to be determined from Standard test pieces which are to be prepared from sample pieces cut lengthwise from the forging from a part of not less sectional dimensions than the body of the forging. Such Standard test pieces are to be machined from the sample pieces without forging down, and the sample pieces are not to be detached from the forging until the heat treatment of such forging has been completed. The test pieces are to be stamped by the Surveyor after the heat treatment. All test pieces are to be selected by the Surveyor and tested in his presence, and he is to satisfy himself that the conditions herein described are fulfilled.

4. **Number of Tests.**—At least one tensile and one cold bend test piece are to be taken from each forging. Where a number of articles are cut from one forging, one tensile and one cold bend test from this whole forging will be sufficient.

5. **Dimensions of Tensile Test Pieces.**—The tensile test pieces are to be turned so as to have a diameter of ·564 inch with a gauge length of 2 inches, or a diameter of ·798 inch with a gauge length of 3 inches, or a diameter of ·977 inch with a gauge length of $3\frac{1}{2}$ inches.

6. **Tensile Tests.**—(*a*) The tensile breaking strength determined from test pieces of Standard dimensions is to be between the limits of 28 and 40 tons per square inch, with a range not exceeding 4 tons per square inch in any one forging, and in no case is the sum of the tensile breaking strength and percentage of elongation, measured on the standard test piece, to be less than 57 for test pieces cut longitudinally. Where the tensile test pieces are required to be taken transversely this sum is to be not less than 52.

(*b*) Stern posts, propeller posts, rudders, and other ship forgings which are to be welded may be made of specially soft Open Hearth Ingot Steel instead of wrought iron, such steel to have a tensile breaking strength between the limits of 22 and 26 tons per square inch, with an elongation on the Standard test piece (**Section 10, clause 5**) of not less than 35 per cent for 22 ton steel and 31 per cent for 26 ton steel; in no case is the sum of the tensile breaking strength

and corresponding elongation to be less than 57. The remaining tests and requirements are to be as prescribed for ordinary ingot steel.

7. **Dimensions of Bend Test Pieces.**—The bend test pieces are to be machined to a rectangular section one inch wide by $\frac{3}{4}$ inch thick, with the edges rounded to a radius of $\frac{1}{16}$th of an inch. They are to be bent over the thinner section. The bending may be performed either by pressure or by blows.

8. **Bend Tests.**—The bend test pieces are to withstand without fracture being bent cold through an angle of 180 degrees, the internal radius of the bend being not greater than $\frac{1}{4}$ inch for test pieces cut longitudinally. Where test pieces are required to be cut transversely the radius of bend is to be not greater than $\frac{1}{2}$ inch.

9. Where it is proposed to use ingot steel forgings of material of tensile strength other than specified above, the proposed limits of tensile strength and elongation and the radius of curvature for bend tests should be submitted for consideration.

10. **Additional Tests before Rejection.**—Where either the tensile or bend test, or both, fail, and the Surveyor considers the fractured test piece or test pieces, or the results obtained therefrom, do not fairly represent the quality of the forging, duplicates of the test or tests which failed are to be made if requested by the Maker. In such cases the quality of the forging is to be judged by the result of the duplicate test or tests and not by the original test or tests which failed.

11. **General.**—The requirements as to heat treatment and testing are intended to apply to rudder heads and main pieces of rudders upon which arms are shrunk, to shafts of all descriptions, also to connecting rods and piston rods which require to be made in several heats. They are not intended to apply to small forgings which during their last stage of manufacture are uniformly heated throughout.

12. **Special Quality Steel for Forgings.**—Where steel material is proposed having other tensile strength than that specified in this Section, the particulars of the mechanical properties of the material should be submitted for consideration.

13. **Forged Drums and Rotors.**—In the case of forged drums and rotors which rotate at high speed, longitudinal, tangential and radial tensile, bend and impact tests should be made, and the proposed limits should be submitted for consideration.

14. **Branding.**—Every forging after it has withstood satisfactorily the prescribed tests, is to be clearly and distinctly marked by the Society's Surveyor indicating that the forging has complied with the Society's requirements.

SEAMLESS STEEL DRUMS FOR BOILERS.

Section 10A. 1. **Process.**—The Steel is to be made by the Open Hearth Process, Acid or Basic.

2. **Discard.**—Sufficient discard shall be made from the top and bottom of each ingot to ensure soundness in the portion used for forging, and sulphur prints may be taken to demonstrate that this condition has been fulfilled.

3. **Forging.**—The forging shall be made from a solid cast ingot, punched, bored or trepanned, or alternatively hollow cast ingots may be used. The resultant wall in the case of the solid cast ingot, or the wall of the hollow ingot, as cast, shall be reduced in thickness by at least two-thirds in the process of forging.

The Committee will be prepared to give consideration to the circumstances of any special case.

4. **Heat Treatment and Testing.**—Sufficient material shall be left on each end of each forging to enable tangential tests to be taken. These tests are to consist of one tensile and one bend test from each end. In the case of open-ended drums the test material shall not be parted off before heat treatment, but if the drums are closed in the test rings may be parted prior to this operation; subsequently the test rings and the forging shall be simultaneously heat treated in the same furnace.

If desired, test pieces may be heated for the purpose of straightening, but this operation must not cause any alteration in the sectional area of the test pieces, which are subsequently to be heat treated simultaneously with the drum.

5. **Mechanical Tests.**—The forging shall conform to the following requirements:—

Tensile strength 28 to 40 tons per square inch, but the difference in the tensile strength between the ends of each forging is not to exceed 4 tons per square inch.

Elongation 29 per cent. to 17 per cent. on standard test piece as per **Section 10, clause 5.** In no case is the sum of the tensile breaking strength and corresponding elongation to be less than 57.

Bend Test:—Test pieces 1 in. by $\frac{3}{4}$ in. to be capable of being bent cold through an angle of 180°, the internal radius of the bend being not greater than that specified below:—

Up to 32 tons per square inch	$\frac{1}{4}$ in.
Above 32 tons and up to 36 tons per square inch	$\frac{3}{8}$ in.
Above 36 tons and up to 40 tons per square inch	$\frac{5}{8}$ in.

6. **Retesting.**—Should either a tensile or bend test fail, two further specimens may be tested and if the results obtained from both are satisfactory the forging shall be accepted. In the event of either or both retests failing, the forging may be again heat treated and re-presented for test.

QUALITY AND TESTING OF BRONZE PROPELLERS AND BRONZE PROPELLER BLADES.

Section 11. 1. **Number of Tests.**—At least one tensile test is to be taken from each casting.

2. **Dimensions of Test Piece.**—The tensile test pieces are to be turned so as to have a diameter of ·564 inch or ·798 inch, with a gauge length of two inches.

3. **Tensile Tests.**—The tensile breaking strength determined from test pieces of standard dimensions is to be not less than 28 tons per square inch, and the sum of the tensile breaking strength and percentage of elongation measured on the standard test piece, is to be not less than 48. In no case, however, is the percentage of elongation to be less than 15.

QUALITY AND TESTING OF ANCHORS FOR STEAM VESSELS, SAILING VESSELS AND TUGS.

Section 12. 1. **Process of Manufacture.**—(*a*) Anchors are to be made of forged wrought iron, or forged open hearth ingot steel, or cast steel; the use of Bessemer steel is prohibited.

(*b*) Each important part of a forged anchor is to be plainly marked by the Makers with the words "Forged Wrought Iron," or "Forged Open Hearth Ingot Steel," a the case may be.

(*c*) Steel Anchor Shackles are to be forged and unwelded.

2. Tests of Anchors.—All anchors, including Stream and Kedge anchors weighing more than 168 lbs. inclusive of stock, are to be tested in accordance with the requirements of the following Table and the Certificates of Test produced.

WEIGHTS AND CORRESPONDING PROOF STRAINS OF ANCHORS.

Weight.	Test.	Weight.	Test.	Weight.	Test.	Weight.	Test.	Weight.	Test.	Weight.	Test.
Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.
1¼	3 13/20	7¼	9 9/20	14½	16 1/20	30	28 12/20	48¾	41 11/20	94½	65 3/20
1½	3 18/20	7½	9 13/20	15	16 10/20	30½	29	49½	42 1/20	95	65 7/20
1¾	4 4/20	7¾	9 18/20	15¼	16 14/20	31	29 7/20	51	43	98	66 10/20
2	4 10/20	8	10 2/20	16¼	17 11/20	32	30 2/20	52½	43 18/20	100	67 5/20
2¼	4 15/20	8¼	10 7/20	16¾	18	32½	30 10/20	54½	45 1/20	101½	67 16/20
2½	5	8½	10 12/20	17	18 5/20	33	30 17/20	56¼	46 3/20	104½	68 19/20
2¾	5 5/20	8¾	10 17/20	17½	18 12/20	33½	31 5/20	58	47 5/20	105½	69 6/20
3	5 10/20	9	11 2/20	18¾	19 13/20	34	31 12/20	60	48 7/20	109	70 12/20
3¼	5 14/20	9¼	11 6/20	19	19 17/20	35½	32 15/20	61½	49 3/20	109½	70 16/20
3½	5 18/20	9½	11 11/20	20½	21 3/20	36	33 2/20	63¾	50 7/20	113½	72 6/20
3¾	6 3/20	9¾	11 15/20	21	21 12/20	36½	33 8/20	65	51	118	74
4	6 7/20	10	12	21¼	21 16/20	37¼	33 18/20	68	52 12/20	122½	75 10/20
4¼	6 12/20	10¼	12 4/20	22	22 7/20	38	34 10/20	68½	52 18/20	127	76 18/20
4½	6 17/20	10½	12 8/20	22½	22 15/20	38¾	34 19/20	72	54 15/20	132	78 10/20
4¾	7 2/20	10¾	12 13/20	23¼	23 6/20	39	35 2/20	72½	55	137	80 1/20
5	7 7/20	11	12 17/20	23½	23 10/20	40	35 15/20	76	56 15/20	142	81 12/20
5¼	7 11/20	11¼	13 2/20	24½	24 6/20	40¾	36 6/20	77	57 5/20	147½	83 6/20
5½	7 16/20	11½	13 7/20	25	24 15/20	42	37 2/20	80	58 10/20	153	85
5¾	8	11¾	13 12/20	25½	25 3/20	42½	37 10/20	81¼	59 2/20	159	86 10/20
6	8 5/20	12	13 17/20	26½	26	44¼	38 15/20	83½	60 5/20		
6¼	8 10/20	12½	14 6/20	27¾	26 18/20	45	39 5/20	85½	61 5/20		
6½	8 15/20	13	14 15/20	28	27 2/20	46	39 17/20	87	61 17/20		
6¾	9	13½	15 3/20	28½	27 10/20	47¾	40 19/20	90	63 5/20		
7	9 5/20	14	15 12/20	29½	28 5/20	48	41 2/20	91	63 12/20		

The weight given in the above Table is either for stockless anchors or for the ordinary type excluding stock. For intermediate weights of anchors the tests may be obtained by interpolation.

CAST STEEL ANCHORS.

Section 13. 1. **General.**—All cast steel anchors in addition to undergoing the statutory tests are to be subjected to the percussive, hammering and bending tests given below.

These tests are to be carefully and completely made in the presence and to the satisfaction of the Society's Surveyors.

2. **Percussive Test.**—(*a*) The anchor, or where anchors are made in more than one piece, each piece is to be raised a given height and then dropped on a steel or iron slab.

For weights of 15 cwts. and below, the height is to be 15 feet, and for weights above 15 cwts. the height is to be 12 feet.

The lowest part of the anchor or piece when suspended is to be at least the given height above the iron slab upon which it is to be dropped.

(*b*) An anchor of the Admiralty pattern is first to be raised vertically to the given height with its shank and arms in a horizontal position, and then let fall from that height.

It is then to be raised a second time to the given height and suspended with the crown downwards. Two steel or iron blocks are to be placed underneath it, and the anchor is to be let fall from this position so that one of the blocks receives it on the middle of one arm, and the other block receives it on the middle of the other arm.

(*c*) The slab for the horizontal test is to be of steel or iron, well laid on a solid concrete foundation to the satisfaction of the Surveyor.

(*d*) If the slab on which the anchor falls is broken by the impact the test is to be repeated until a slab is made that does not break.

(*e*) The blocks for the vertical test are to be solid and of sufficient height to prevent the crown of the anchor from touching the slab, and are to be to the satisfaction of the Surveyor.

3. **Hammering Test.**—Provided the percussive test has been satisfactory, the anchor or piece is to be slung and thoroughly hammered over its parts with a sledge hammer weighing not less than 7 lb., and is required to give under this treatment such a clear ring in all its parts as shall satisfy the Surveyor that the casting is sound and that no flaws have developed by the application of the preceding percussive tests.

4. **Bending Test.**—(*a*) Cast steel may be passed as sufficiently ductile for anchors when a piece of each casting, 8 inches in length, is cut from the casting, turned to one inch in diameter, and is then bent cold by hammering through an angle of 90 degrees over a radius of $1\frac{1}{2}$ inches, without showing signs of flaw or fracture.

(*b*) A piece is to be cast on each cast steel anchor or on each portion of such anchor when it is made of more than one casting, and each piece is to be of sufficient size to enable one test piece of the size stated above to be cut out of it, or it may be (at the discretion of the Manufacturer) of sufficient size to enable four test pieces to be cut out of it.

Where it is only of sufficient size to enable one test piece to be cut out of it, that piece is to be subjected to the bending test named in paragraph (*a*) above, and should it fail to withstand the test the casting is to be rejected.

Where the piece is large enough to enable four test pieces to be cut out of it, one of these is to be turned in a lathe to one inch in diameter for a length of 8 inches, and bent cold through an angle of 90° over a radius of $1\frac{1}{2}$ inches, and should the piece withstand this test without flaw or fracture it shall be deemed to have withstood a satisfactory test for ductility.

Should the one test piece not pass this test, all or any of the other three test pieces may be tested in a similar manner, and should any one of the four test pieces pass this test, the anchor, or part of the anchor, as the case may be, shall be deemed so far satisfactory.

5. **Heat Treatment.**—Each anchor is to be thoroughly heat treated and marked "Annealed Steel."

TESTS FOR CHAIN CABLES AND STREAM CHAINS.

Section 14. 1. **Tests for Chain Cables and Stream Chains.**—(*a*) All stud link chain cables and stream chains are to be tested in accordance with the requirements of the following Table and the certificates of test produced.

STUD LINK CHAIN CABLES.

Minimum Size.	Cables of Wrought Iron.		Cables of Special Steel.		Minimum Weight per length of 15 fms.
	Proved to Statutory Test.	Breaking Test.	Proved to Statutory Test.	Breaking Test.	
Ins.	Tons.	Tons.	Tons.	Tons.	Cwts.
$\frac{7}{16}$	$3\frac{4}{10}$	$5\frac{1}{10}$	$4\frac{8}{10}$	$7\frac{1}{10}$	$1\frac{3}{4}$
$\frac{8}{16}$	$4\frac{5}{10}$	$6\frac{3}{4}$	$6\frac{3}{10}$	$9\frac{5}{10}$	$2\frac{1}{8}$
$\frac{9}{16}$	$5\frac{5}{8}$	$8\frac{4}{10}$	$7\frac{9}{10}$	$11\frac{8}{10}$	$2\frac{5}{8}$
$\frac{10}{16}$	7	$10\frac{5}{10}$	$9\frac{8}{10}$	$14\frac{7}{10}$	$3\frac{1}{4}$
$\frac{11}{16}$	$8\frac{5}{10}$	$12\frac{3}{4}$	$11\frac{9}{10}$	$17\frac{191}{10}$	$3\frac{5}{8}$
$\frac{12}{16}$	$10\frac{1}{8}$	$15\frac{1}{8}$	$14\frac{2}{10}$	$21\frac{2}{10}$	$4\frac{3}{8}$
$\frac{13}{16}$	$11\frac{7}{8}$	$17\frac{8}{10}$	$16\frac{6}{10}$	$24\frac{9}{10}$	$5\frac{1}{8}$
$\frac{14}{16}$	$13\frac{3}{4}$	$20\frac{5}{8}$	$19\frac{3}{10}$	$28\frac{9}{10}$	$5\frac{7}{8}$
$\frac{15}{16}$	$15\frac{8}{10}$	$23\frac{7}{10}$	$22\frac{1}{10}$	$33\frac{2}{10}$	$6\frac{3}{4}$
1	18	27	$25\frac{2}{10}$	$37\frac{8}{10}$	$7\frac{5}{8}$
$1\frac{1}{16}$	$20\frac{3}{10}$	$30\frac{4}{10}$	$28\frac{4}{10}$	$42\frac{6}{10}$	$8\frac{5}{8}$
$1\frac{2}{16}$	$22\frac{3}{4}$	$34\frac{1}{8}$	$31\frac{9}{10}$	$47\frac{8}{10}$	$9\frac{3}{4}$
$1\frac{3}{16}$	$25\frac{3}{8}$	38	$35\frac{5}{10}$	$53\frac{2}{10}$	$10\frac{7}{8}$
$1\frac{4}{16}$	$28\frac{1}{8}$	$42\frac{1}{8}$	$39\frac{4}{10}$	59	12
$1\frac{5}{16}$	31	$46\frac{1}{2}$	$43\frac{4}{10}$	$65\frac{1}{10}$	$13\frac{1}{4}$
$1\frac{6}{16}$	34	51	$47\frac{6}{10}$	$71\frac{4}{10}$	$14\frac{1}{2}$
$1\frac{7}{16}$	$37\frac{1}{8}$	$55\frac{5}{8}$	52	$77\frac{9}{10}$	$15\frac{7}{8}$
$1\frac{8}{16}$	$40\frac{5}{10}$	$58\frac{7}{10}$	$56\frac{7}{10}$	$82\frac{2}{10}$	$17\frac{1}{4}$
$1\frac{9}{16}$	$43\frac{9}{10}$	$61\frac{4}{10}$	$61\frac{4}{10}$	86	$18\frac{3}{4}$
$1\frac{10}{16}$	$47\frac{5}{10}$	$66\frac{5}{10}$	$66\frac{5}{10}$	$93\frac{1}{10}$	20
$1\frac{11}{16}$	$51\frac{1}{4}$	$71\frac{3}{4}$	$71\frac{3}{4}$	$100\frac{5}{10}$	$21\frac{1}{2}$
$1\frac{12}{16}$	$55\frac{1}{8}$	$77\frac{1}{8}$	$77\frac{1}{8}$	108	$23\frac{1}{8}$
$1\frac{13}{16}$	$59\frac{1}{8}$	$82\frac{3}{4}$	$82\frac{3}{4}$	$115\frac{9}{10}$	$24\frac{7}{8}$
$1\frac{14}{16}$	$63\frac{1}{4}$	$88\frac{5}{10}$	$88\frac{5}{10}$	$123\frac{9}{10}$	$26\frac{5}{8}$
$1\frac{15}{16}$	$67\frac{5}{10}$	$94\frac{5}{10}$	$94\frac{5}{10}$	$132\frac{3}{10}$	$28\frac{3}{8}$
2	72	$100\frac{8}{10}$	$100\frac{8}{10}$	$141\frac{1}{10}$	30
$2\frac{1}{16}$	$76\frac{5}{10}$	$107\frac{1}{10}$	$107\frac{1}{10}$	$149\frac{9}{10}$	$31\frac{7}{8}$
$2\frac{2}{16}$	$81\frac{1}{4}$	$113\frac{3}{4}$	$113\frac{3}{4}$	$159\frac{3}{10}$	$33\frac{3}{4}$
$2\frac{3}{16}$	$86\frac{1}{8}$	$120\frac{5}{10}$	$120\frac{5}{10}$	$168\frac{7}{10}$	$35\frac{7}{8}$
$2\frac{4}{16}$	$91\frac{1}{8}$	$127\frac{5}{10}$	$127\frac{5}{10}$	$178\frac{5}{10}$	$37\frac{7}{8}$
$2\frac{5}{16}$	$96\frac{1}{4}$	$134\frac{3}{4}$	$134\frac{3}{4}$	$188\frac{3}{4}$	40
$2\frac{6}{16}$	$101\frac{5}{10}$	$142\frac{1}{10}$	$142\frac{1}{10}$	$198\frac{9}{10}$	$42\frac{1}{4}$
$2\frac{7}{16}$	$106\frac{9}{10}$	$149\frac{5}{8}$	$149\frac{5}{8}$	$209\frac{5}{10}$	$44\frac{1}{2}$
$2\frac{8}{16}$	$112\frac{5}{10}$	$157\frac{5}{10}$	$157\frac{5}{10}$	$220\frac{5}{10}$	47
$2\frac{9}{16}$	$116\frac{7}{10}$	$163\frac{3}{8}$	$163\frac{3}{8}$	$228\frac{7}{10}$	$49\frac{1}{2}$
$2\frac{10}{16}$	$120\frac{9}{10}$	$169\frac{1}{4}$	$169\frac{1}{4}$	237	52
$2\frac{11}{16}$	$125\frac{1}{10}$	$175\frac{1}{8}$	$175\frac{1}{8}$	$245\frac{2}{10}$	$54\frac{1}{2}$
$2\frac{12}{16}$	$129\frac{3}{10}$	181	181	$253\frac{4}{10}$	$57\frac{1}{8}$
$2\frac{13}{16}$	$133\frac{4}{10}$	$186\frac{3}{4}$	$186\frac{3}{4}$	$261\frac{5}{10}$	$59\frac{7}{8}$
$2\frac{14}{16}$	$137\frac{6}{10}$	$192\frac{5}{8}$	$192\frac{5}{8}$	$269\frac{7}{10}$	$62\frac{5}{8}$
$2\frac{15}{16}$	$141\frac{7}{10}$	$198\frac{3}{8}$	$198\frac{3}{8}$	$277\frac{7}{10}$	$65\frac{1}{2}$
3	$145\frac{8}{10}$	$204\frac{1}{10}$	$204\frac{1}{10}$	$285\frac{7}{10}$	$68\frac{3}{8}$
$3\frac{1}{16}$	$149\frac{8}{10}$	$209\frac{7}{10}$	$209\frac{7}{10}$	$293\frac{6}{10}$	$71\frac{1}{4}$
$3\frac{2}{16}$	$153\frac{3}{4}$	$215\frac{1}{4}$	$215\frac{1}{4}$	$301\frac{4}{10}$	$74\frac{1}{4}$
$3\frac{3}{16}$	$157\frac{7}{10}$	$220\frac{3}{4}$	$220\frac{3}{4}$	$309\frac{1}{10}$	$77\frac{3}{8}$
$3\frac{4}{16}$	$161\frac{6}{10}$	$226\frac{2}{10}$	$226\frac{2}{10}$	$316\frac{7}{10}$	$80\frac{3}{8}$
$3\frac{5}{16}$	$165\frac{4}{10}$	$231\frac{5}{10}$	$231\frac{5}{10}$	$324\frac{1}{10}$	$83\frac{5}{8}$
$3\frac{6}{16}$	$169\frac{1}{8}$	$236\frac{3}{4}$	$236\frac{3}{4}$	$331\frac{5}{10}$	$86\frac{7}{8}$
$3\frac{7}{16}$	$172\frac{3}{4}$	$241\frac{8}{10}$	$241\frac{8}{10}$	$338\frac{5}{10}$	$90\frac{1}{8}$
$3\frac{8}{16}$	$176\frac{4}{10}$	$246\frac{9}{10}$	$246\frac{9}{10}$	$345\frac{7}{10}$	$93\frac{1}{2}$

(*b*) Unstudded close-link chains will be accepted as cables if tested in accordance with the requirements of the following Table and the certificates of test produced.

SHORT LINK CHAIN CABLES.

Minimum Size.	Proved to Statutory Test.	Breaking Test.	Minimum Weight per length of 15 fms.	Minimum Size.	Proved to Statutory Test.	Breaking Test.	Minimum Weight per length of 15 fms.
Ins.	Tons.	Tons.	Cwts.	Ins.	Tons.	Tons.	Cwts.
$\frac{7}{16}$	$2\frac{1}{4}$	$4\frac{1}{2}$	2	$1\frac{4}{16}$	$18\frac{3}{4}$	$37\frac{1}{2}$	$12\frac{7}{8}$
$\frac{8}{16}$	3	6	$2\frac{1}{2}$	$1\frac{5}{16}$	$20\frac{5}{8}$	$41\frac{1}{4}$	$14\frac{1}{8}$
$\frac{9}{16}$	$3\frac{3}{4}$	$7\frac{1}{2}$	3	$1\frac{6}{16}$	$22\frac{5}{8}$	$45\frac{1}{4}$	$15\frac{1}{2}$
$\frac{10}{16}$	$4\frac{5}{8}$	$9\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{7}{16}$	$24\frac{3}{4}$	$49\frac{1}{2}$	17
$\frac{11}{16}$	$5\frac{5}{8}$	$11\frac{1}{4}$	4	$1\frac{8}{16}$	27	54	$18\frac{3}{8}$
$\frac{12}{16}$	$6\frac{3}{4}$	$13\frac{1}{2}$	$4\frac{3}{4}$	$1\frac{9}{16}$	$29\frac{1}{4}$	$58\frac{1}{2}$	$19\frac{7}{8}$
$\frac{13}{16}$	$7\frac{9}{10}$	$15\frac{8}{10}$	$5\frac{1}{2}$	$1\frac{10}{16}$	$31\frac{5}{8}$	$63\frac{1}{4}$	$21\frac{1}{2}$
$\frac{14}{16}$	$9\frac{1}{8}$	$18\frac{1}{4}$	$6\frac{3}{8}$	$1\frac{11}{16}$	$34\frac{1}{8}$	$68\frac{1}{4}$	$23\frac{1}{8}$
$\frac{15}{16}$	$10\frac{1}{2}$	21	$7\frac{1}{4}$	$1\frac{12}{16}$	$36\frac{3}{4}$	$73\frac{1}{2}$	25
1	12	24	$8\frac{1}{4}$	$1\frac{13}{16}$	$39\frac{4}{10}$	$78\frac{8}{10}$	$26\frac{7}{8}$
$1\frac{1}{16}$	$13\frac{1}{2}$	27	$9\frac{1}{4}$	$1\frac{14}{16}$	$42\frac{1}{8}$	$84\frac{1}{4}$	$28\frac{7}{8}$
$1\frac{2}{16}$	$15\frac{1}{8}$	$30\frac{1}{4}$	$10\frac{3}{8}$	$1\frac{15}{16}$	45	90	$30\frac{7}{8}$
$1\frac{3}{16}$	$16\frac{9}{10}$	$33\frac{8}{10}$	$11\frac{5}{8}$	2	48	96	33

TESTS FOR STEEL WIRE TOWLINES, HAWSERS AND WARPS, AND STANDING RIGGING.

Section 15. 1. **General.**—Each Manufacturer is required to provide on his premises machines suitable for making the prescribed tests satisfactorily, and the works are to be at all times open to the inspection of the Society's Surveyors, who are empowered to retest any rope for which a certificate has been issued by the Manufacturer.

2. **Certificates.**—Printed forms of certificates, approved by the Committee, are to be signed by the Manufacturers, and will be supplied to them upon application to the Secretary.

3. **Quality of Ropes.**—The Rules set forth hereunder apply to four qualities of galvanised steel wire ropes, one of which is suitable for steel wire standing rigging, and is composed of six strands of seven wires each. No fibre is to be used in the strands, a fibre core only being fitted.

The other three qualities of rope are for towlines hawsers and warps, and are designated respectively :—flexible steel wire rope, which is composed of 6 strands of 12 wires each ; special flexible, in which 6 strands of 24 wires each are used; and special flexible which has 6 strands of 30 wires each, a fibre core being fitted in each strand.

4. **Tests.**—A portion of each steel wire rope is required to stand the tensile test prescribed in the Table, and may be pulled as a finished rope, or a short length of each of the wires composing the finished steel rope may be tested separately, in which case the minimum breaking load of the rope shall be considered to be the sum of the aggregate breaking loads of the individual wires, less a percentage for laying up, as follows :—

6 × 7	.....	5 per cent.
6 × 12	.....	$7\frac{1}{2}$ „
6 × 24	.....	10 „
6 × 30	.....	$12\frac{1}{2}$ „

Each wire will be required to be capable of being twisted round itself not less than nine times, and of being untwisted eight times and straightened without breaking or splitting.

Sizes and Breaking Tests of Steel Wire Ropes.

Circumference of Ropes.	Standing Rigging Wire Ropes. (*a*)	Galvanised Flexible Wire Ropes. (*b*)	Galvanised Special Flexible Wire Ropes. (*c*)	(*d*)
	6×7	6×12	6×24	6×30
Inches.	Tons.	Tons.	Tons.	Tons.
1	1·8	2·0	2·6	2·6
1¼	2·9	3·1	4·4	3·6
1½	4·2	4·8	6·1	5·4
1¾	5·8	6·4	8·7	7·5
2	7·6	8·3	11·2	10·0
2¼	9·5	10·8	14·7	12·8
2½	11·8	13·2	17·7	15·2
2¾	14·3	15·2	21·1	19·6
3	17·1	18·6	25·7	23·5
3¼	20·1	21·7	29·7	25·6
3½	23·4	25·7	35·2	30·1
3¾	26·9	29·3	39·9	34·9
4	30·3	33·2	44·9	40·1
4¼	34·3	36·4	51·5	45·6
4½	38·5	43·3	58·6	51·4
4¾	43·0	47·0	64·6	57·6
5		52·8	70·9	64·2
5¼			77·5	71·2
5½			84·4	76·6
5¾			91·5	82·3
6			99·1	92·1
6¼			104·5	98·3
6½			112·3	104·7
6¾			120·3	111·2
7			130·7	120·0
7½				131·8
8				148·8

71, Fenchurch Street, London, E.C.3.
17th October, 1946.

QUALITY AND TESTING OF STEEL FOR STEAM, FEED, AIR AND OIL PRESSURE PIPES, AND SMOKE TUBES.

Section 16. 1. **Material.**—The steel is to be made by the open hearth process.

2. **Tests for Steam Pipes, Feed Pipes and Compressed Air Pipes.**—(*a*) **Lap Welded and Riveted.**—The tensile strength of the steel is not to exceed 28 tons per square inch, with a minimum elongation of 25 per cent on a Standard test piece having a gauge length of 8 inches.

(*b*) **Solid Drawn.**—The tensile strength of the steel is not to exceed 28 tons per square inch, with a minimum elongation of 20 per cent on a Standard test piece having a gauge length of 8 inches.

3. **Tests for Oil Pressure Pipes.—Solid Drawn.**—The tensile strength of the steel is not to exceed 28 tons per square inch, with a minimum elongation of 20 per cent on a Standard test piece having a gauge length of 8 inches.

4. **Tests for Smoke Tubes.—Lapwelded and Seamless.**—The tensile strength of the material is not to exceed 28 tons per square inch, with a minimum elongation of 20 per cent on a Standard test piece having a gauge length of 8 inches.

STEEL MANUFACTURERS
AND
PROVING ESTABLISHMENTS.

LLOYD'S REGISTER OF SHIPPING.

STEEL MANUFACTURERS.

The following firms having applied to have the steel produced by them tested by a Surveyor to this Society and their mode of procedure reported upon, their applications have been complied with and the Surveyors' reports found satisfactory by the Committee.

Firms in Great Britain and Ireland.

Allen, Edgar, & Co., Lim., Imperial Steel Works, Tinsley, Sheffield. (*Steel castings.*)
Alston Foundry Co., Lim., Nent Force Foundry, Alston, Cumberland.
Appleby-Frodingham Steel Co., Lim., Scunthorpe, Lincs.,
Appleby Works. (*Steel plates and blooms.*)
Frodingham Works. (*Sections, bars and blooms.*)
Atlas (The) Steel Foundry and Engineering Co., Lim., Armadale, West Lothian. (*Steel castings.*)
Babcock & Wilcox, Lim., Renfrew. (*Small steel castings.*)
Baird, Archibald, & Son, Lim., Hamilton, near Glasgow. (*Steel castings.*)
Bairds & Scottish Steel, Lim., Coatbridge, Lanarkshire.
Northburn Works. (*Steel ingots and billets, sections and bars.*)
Waverley Works. (*Sections and bars.*)
Victoria Works. (*Sections and bars.*)
Woodside Works. (*Sheets and strips.*)
Coats Works. (*Sections and bars.*)
Rochsolloch Works. (*Sections and bars.*)
Baker Bessemer, J., Lim., Kilnhurst Steel Works, near Rotherham. (*Ingots and forgings.*)
Beardmore, William, & Co., Lim., Parkhead, Glasgow.
Blackett, Hutton & Co., Cleveland Steel and Iron Works, Guisborough, Yorkshire. (*Steel castings.*)
Blaenavon Co., Lim., near Pontypool, Mon. (*Steel ingots.*)
Blair, Geo., & Co., Lim., Teams Street, Gateshead, 8.
Bond's Foundry Co., Tow Law, Co. Durham. (*Small steel castings.*)
Braby, Fredk., & Co., Lim., Eclipse Iron and Galvanizing Works, Glasgow. (*Rolling Mills for plates up to ½ in. in thickness.*)
British Rolling Mills, Lim., Brymill Works, Tipton, Staffs. (*Cold drawn bright steel bars.*)
Brockhouse Castings, Lim., Wednesfield, Wolverhampton. (*Small steel castings.*)
Brown, Bayley's Steel Works, Lim., Sheffield. (*Steel ingots, forgings, and bars.*)
Brown, The David, Foundries Co., Penistone, Yorks. (*Steel castings.*)
Brown, Lenox & Co., Lim., Pontypridd. (*Steel castings.*)
Cargo Fleet Iron Co., Lim. (*See* South Durham Steel & Iron Co., Lim.)
Carntyne Steel Castings Co., Lim., Moorpark, Renfrew. (*Steel castings.*)
Catton & Co., Lim., Yorkshire Steel Foundry, Hunslet, Leeds. (*Steel castings.*)
Clyde Alloy Steel Co., Lim., Craigneuk Works, Flemington, Motherwell. (*Steel castings.*)
Coghlan Steel & Iron Co., Lim., Hunslet Forge, Leeds. (*Rolling Mills for bars; forgings.*)

Coltness Iron Co., Lim., Newmains, Lanarkshire. (*Steel castings.*)

Colvilles Lim.,

Dalzell Steel and Iron Works, Motherwell, Lanarkshire.

Clydebridge Steel Works, Cambuslang, near Glasgow.

Glengarnock Iron and Steel Works, Glengarnock, Ayrshire. (*Sections and bars.*)

Consett Iron Co., Lim., Blackhill, Durham.

Crofts (Engineers), Lim., Thornbury, Bradford. (*Steel castings.*)

Cruikshank & Co., Lim., Denny, Stirlingshire. (*Small steel castings.*)

Darlington Forge Co., Lim., Darlington. (*Steel castings and forgings.*)

Darlington & Simpson, Rolling Mills Lim., Darlington. (*Rolling Mills for small sections and bars.*)

Davy & United Roll Foundry, Lim., Empire Works, Haverton Hill, Billingham, Co. Durham. (*Steel castings.*)

Dorman, Long & Co., Lim. (Incorporating Bolckow, Vaughan & Co., Lim.),

Britannia Steel Works, Middlesbrough.

Cleveland Iron and Steel Works, South Bank-on-Tees.

Redcar Iron and Steel Works, Redcar.

English Steel Corporation, Lim.,

North Street Works, Openshaw, Manchester. (*Steel castings, forgings, bars and plates up to ½ in. in thickness.*)

Vickers Works, Sheffield. (*Steel ingots, blooms, bars, forgings and castings.*)

Cammell Laird's Grimesthorpe Works, Sheffield. (*Steel ingots, forgings and castings.*)

Etna Iron and Steel Co., Lim., Motherwell, Lanarkshire. (*Rolling Mills for sections and bars.*)

Firth, Thomas, & John Brown, Lim.,

Atlas Works, Sheffield. (*Ingots, forgings, rolled bars and billets.*)

Norfolk Works, Sheffield. (*Steel castings and rolled strips.*)

Scunthorpe Works, Scunthorpe, Lincs. (*Steel castings.*)

Firth Vickers Stainless Steels, Lim., Sheffield. (*Rolling Mills for plates, bars and sections; also steel castings.*)

Fox (Samuel) & Co., Lim., Stocksbridge Works, near Sheffield. (*Steel ingots.*)

Glanmor Foundry Co., Llanelly. (*Steel castings.*)

Guest, Keen & Nettlefolds, Lim.,

Castle Works, Rolling Mills, Cardiff. (*Rolling Mills for bars and strips.*)

Cwmbran Works, near Newport, Mon. (*Rolling Mills for flat, round and angle bars.*)

Guest Keen Baldwins Iron & Steel Co., Lim.,

Port Talbot Steel Works, Port Talbot, South Wales.

Margam Steel Works, Port Talbot. (*Steel ingots and billets.*)

East Moors Steel Works, Cardiff. (*Steel ingots, blooms and billets; sections and bars.*)

Hadfields, Lim., East Hecla Works, Sheffield. (*Steel ingots, blooms, billets, forgings, bars, special sections and castings.*)

Halesowen (The) Steel Co., Lim., Halesowen, near Birmingham. (*Cold drawn bright steel bars.*)

Hamilton, A., & Sons, Lim., Victoria Foundry, East Moors, Cardiff. (*Small steel castings.*)

Head, Wrightson & Co., Lim., Thornaby-on-Tees. (*Steel castings.*)

Hopkinsons, Lim., Britannia Works, Huddersfield, Yorkshire. (*Steel castings.*)

Hyde (Robert) & Son, Lim., North Stafford Steel Works, Stoke-on-Trent. (*Small steel castings.*) Also Works at Chesterfield.

Industrial Steels, Lim., Stevenson Road, Sheffield. (*Steel ingots, blooms, billets and bars.*)

Jackson, P. R., & Co., Lim., Salford, Manchester. (*Steel castings.*)

Jarrow Metal Industries, Lim., Western Road, Jarrow. (*Steel castings.*)

Jessop, W., & Sons, Lim., Brightside Works, Sheffield. (*Steel ingots, blooms, bars, forgings and castings.*)

Jopling, E., & Sons, Pallion, Sunderland. (*Steel castings.*)

Kirkstall Forge Lim., Leeds. (*Rolling Mills for bars, steel forgings and heavy drop forgings.*)

Kryn & Lahy (1928), Lim., Letchworth, Hertfordshire. (*Steel castings.*)

Lake & Elliot, Lim., Proprietors of the Braintree Castings Co., Braintree, Essex. (*Small steel castings.*)

Lanarkshire Steel Co., Lim., Motherwell, Lanarkshire.

Lancashire Steel Corporation, Lim., Irlam, Manchester. (*Billets, bars, sections, and steel castings*)
Pearson & Knowles Works, Warrington, Lancs. (*Rolling Mills for sections and bars.*)
Leyland Motors Lim., Farington Foundries, Leyland, Yorks. (*Steel castings.*)
Lilleshall Co., Lim., Priors Lee Hall, nr. Shifnal, Salop. (*Rolling Mills for sections and bars.*)
Lloyd, F. H., & Co., Lim., James Bridge, near Wednesbury, Staffordshire. (*Steel castings.*)
London Midland & Scottish Railway Co., Crewe. (*Steel ingots.*)
Lysaght, John, Lim., Scunthorpe, Lincs. (*Steel ingots, billets and slabs.*)
Martin, William, Sons & Co., Dundyvar Iron & Steel Works, Coatbridge, Lanarkshire. (*Rolling Mills for sections and bars.*)
Mills, Exors. of James, Lim., Bredbury Steel Works & Rolling Mills, near Stockport. (*Rolling Mills for steel bars.*)
Ministry of Supply, Barrow Works.
Ministry of Supply, Monk Bridge Factory, Leeds, 12. (*Rolled bars and forgings.*)
Monks, Hall & Co., Lim., Warrington. (*Rolling Mills for bars.*)
National Steel Foundry (1914), Lim. (The), Kirkland Works, Leven, Fifeshire. (*Steel castings.*)
New Jarrow Steel Co., Lim., Blackett Street, Jarrow-on-Tyne. (*Rolling Mills for sections and rounds.*)
Newman Industries, Lim., Yate, Bristol. (*Steel castings.*)
North British (The) Steel Foundry, Lim., Balbardie Steel Works, Bathgate. (*Small steel castings.*)
North British (The) Steel Foundry, Lim., Bonnington Steel Works. (*Small steel castings.*)
Osborn, S., & Co., Clyde Steel & Iron Works, Sheffield. (*Steel castings.*)
Park Gate Iron & Steel Co., Lim., Rotherham, Yorkshire.
Parker Foundry (1929) Lim., "Tropenas" Steel Works, Derby. (*Small steel castings.*)
Partridge, Jones & John Paton, Lim., Pontymister Foundry, Risca, nr. Newport, Mon. (*Steel castings.*)
Patent Shaft & Axletree Co., Lim., Wednesbury, Staffordshire.
Raine & Co., Lim., Delta Iron & Steel Works, Derwenthaugh, Newcastle-on-Tyne. (*Rolling Mills for sections and bars.*)
Redheugh Iron & Steel Co. (1936), Lim., Teams, Gateshead-on-Tyne. (*Rolling Mills.*)
Renton & Fisher, Lim., Hopetoun Steel Works, Bathgate. (*Steel castings.*)
Round Oak Steel Works, Lim., Brierley Hill, Staffordshire. (*Sections and bars.*)
Ryder Brothers, Lim., (Beehive Steel Foundry), Bolton. (*Small steel castings.*)
Shaw, W., & Co., Middlesbro'-on-Tees. (*Steel castings.*)
Shelton Iron, Steel & Coal Co., Lim., Stoke-on-Trent. (*Steel ingots, billets, bars and sections.*)
Skinningrove Iron Co., Lim., Skinningrove Iron Works, Saltburn-by-the-Sea. (*Sections and bars.*)
Smith & McLean, Lim., Mossend, and Gartcosh, Lanarkshire. (*Rolling Mills for plates up to $\frac{5}{16}$ in. in thickness.*)
South Durham Steel & Iron Co., Lim., Middlesbrough. *Works at* West Hartlepool and Cargo Fleet.
Springfield Steel Co., Lim., 1323, London Road, Glasgow. (*Steel castings.*)
Steel Company of Scotland, Lim., Newton, Glasgow; and Blochairn, Glasgow.
Steel, Peech & Tozer, Sheffield. (*Steel ingots, blooms, forgings, rivet and stay bars.*)
Stewarts & Lloyds, Lim., (Clydesdale Steel and Iron Works), Mossend, Lanarkshire. (*Steel ingots only.*)
Stewarts & Lloyds, Lim., Sun Foundry, Coatbridge, Lanarkshire. (*Steel castings.*)
Stewarts & Lloyds, Lim., Alfred Hickman Branch, Bilston, Staffordshire.
Stewarts & Lloyds, Lim., Landore, S. Wales. (*Seamless steel tubes for all purposes.*)
Stockton Steel Foundry Co., Lim., Stockton-on-Tees. (*Steel castings.*)
Summerson, Thomas, & Sons, Lim., Darlington. (*Small steel castings.*)
Taylor Bros. & Co., Lim., Trafford Park Steel Works, Manchester. (*Steel ingots.*)
Thomas (Richard) & Baldwins, Lim., Redbourn Works, Scunthorpe, Lincolnshire. (*Steel ingots and billets.*)
United Strip and Bar Mills, The Ickles, Sheffield. (*Rolling Mills for bars.*)
Vickers-Armstrongs, Lim.
Barrow-in-Furness. (*Steel castings and forgings.*)
Elswick Works, Elswick, Northumberland. (*Steel castings.*)

Washington Steel Foundries, Lim., Washington Station S.O., Co. Durham. (*Steel castings.*)

West Lothian Steel Foundry Co., Lim., Hardhill Works, Armadale, West Lothian. (*Small steel castings.*)

Whitehead Iron & Steel Co., Lim., Courtybella Works, Newport, Mon. (*Rolling Mills for steel strips, bars and sections.*)

Whitehead Thomas Bar and Strip Co., Lim., Redbourn Works, Scunthorpe, Lincs. (*Rolling Mills for steel bars and strips.*)

Williams (John), & Co. (Wishaw), 1922, Lim., Excelsior Iron & Steel Works, Craigneuk, Motherwell. (*Rolling Mills for plates up to $\frac{5}{16}$ in. in thickness.*)

Wolsingham Steel Co., Lim., Wolsingham, Co. Durham. (*Steel castings and forgings.*)

FIRMS IN COUNTRIES OTHER THAN GREAT BRITAIN AND IRELAND.

ALPHABETICALLY ARRANGED.

All steel works in Germany and Japan which were on the approved list before the war have been omitted from the list which follows.

In countries which were occupied by forces from these nations, information regarding the steel works is still incomplete and names of the works have only been included if inspection has been carried out since the war.

In the following list the name of each works is followed by the place of residence of the Surveyor giving attendance thereat.

A.I. Iron & Steel Foundry, Lim., Vancouver. (*Small steel castings.*) (VANCOUVER.)

A.S.S.A. Acciaierie di Susa Società Anonima, Torino, Italy. *Head Office* in Turin. *Works* at Susa. (*Steel castings.*) (GENOA.)

Acciaieria e Ferriera del Caleotto Società Anonima, Lecco Italy. (*Steel ingots, bars, small sections and small forgings.*) (GENOA.)

Acciaieria e Tubificio di Brescia, Società Anonima, Brescia, Italy. (*Steel ingots, sections and bars, steel castings, weldless drawn or water gas welded tubular material.*) (GENOA.)

Acciaierie e Ferriere Lombarde Falck. *Head Office:* Milan. *Works* at Milan. (*Weldless rolled or drawn steel tubes.*) (GENOA.)

'Unione' *Works* at Sesto S. Giovanni. (*Steel ingots, sections, bars, forgings, also steel castings.*) (GENOA.)

'Concordia' *Works* at Sesto S. Giovanni. (*Rolling Mills for steel plates.*) (GENOA.)

Acciaierie Elettriche Pio Faggian, La Spezia, Italy. (*Small steel castings.*) (GENOA.)

Aciéries de Haine St. Pierre et Lesquin, Société Anonyme. *Works* at Haine St. Pierre, Belgium. (*Steel castings.*) (ANTWERP.)

Aciéries et Ateliers de Grosse Forge, Maurice Dembiermont & Cie., Hautmont (Nord), France. (*Steel forgings.*) (PARIS.)

Aciéries & Minières de la Sambre.
Works at Monceau-sur-Sambre, Belgium. (*Rolling Mills for bars.*) (ANTWERP.)

Works at Nimy, Belgium. (*Rolling Mills for bars.*) (ANTWERP.)

Aktiebolag Svenska Jarnvagsverkstaderna, Linkoping, Sweden. (*Steel castings.*) (STOCKHOLM.)

Aktiebolaget Abjörn Anderson, Svedala, near Malmö, Sweden. (*Steel castings.*) (MALMÖ.)

Aktiebolaget Bofors, Bofors, Sweden. (*Melting Furnaces and Foundry* at Bofors.) (GOTHENBURG.)

Aktiebolaget Kanthal, Hallstahammar, Sweden. (*Steel castings.*) (STOCKHOLM.)

Aktiebolaget Motala Verkstad, Motala Verkstad, Sweden. (*Melting Furnaces, Rolling Mills and Forge; also steel castings.*) (GOTHENBURG.)

Alan Wood Steel Company, Conshohocken and Ivy Rock, Pa., U.S.A. (*Blooms, billets and thin plates.*) (PHILADELPHIA.)

Algoma Steel Corporation, Lim., Sault St. Marie, Ontario, Canada. (*Steel billets, bars and angles.*) (TORONTO.)

Allegheny Steel Co., Brackenridge, Pa., U.S.A. (*Also steel castings.*) (PITTSBURGH.)

Altos Hornos de Vizcaya. S.A., Fabrica de Sagunto, Sagunto, Spain. (*Steel ingots, bars and sections.*) (BARCELONA.)

American Locomotive Co., Railway Steel Spring Division, Latrobe, Pa., U.S.A. (*Steel ingots.*) (PITTSBURGH, PA.)

American Rolling Mill Co., Middletown, O., U.S.A. (*Steel castings and forgings.*) (CLEVELAND, O.)

American Steel Foundries, Newark, N.J., U.S.A. (*Steel castings.*) (NEW YORK.)

Ansaldo Società Anonima, Stabilimento Fossati, Genoa-Sestri, Italy. (*Steel forgings.*) (GENOA.)

Atlantic Steel Castings Co., Chester, Pa., U.S.A. (*Steel castings.*) (PHILADELPHIA.)

Atlas Steels, Lim., Welland, Ontario, Canada. (*Steel ingots and bars.*) (TORONTO.)

Australian Iron & Steel, Lim., Port Kembla, N.S.W. (*Steel plates, bars, sections and forgings.*) (SYDNEY, N.S.W.)

Avesta Jernverks Aktiebolag, Avesta, Sweden. (*Steel plates, sections and castings; also high pressure air receivers.*) (STOCKHOLM.)

Bengal Steel Corporation, Burnpur, India. (*Sections and angles.*) (CALCUTTA.)

Bethlehem Pacific Coast Steel Corporation, Los Angeles 54, Cal., U.S.A. (*Round bars.*) (LOS ANGELES.)

Bethlehem Steel Co.,

Bethlehem, Pa., U.S.A. (*Steel ingots, forgings, bars and sections.*) (PHILADELPHIA.)

Buffalo, N.Y., U.S.A. (CLEVELAND, O.)

Cambria Works, Johnstown, Pa., U.S.A. (PITTSBURGH.)

Lebanon, Pa., U.S.A. (*Rolling Mills for bars.*) (PHILADELPHIA.)

Seattle, Wash., U.S.A. (*Sections and bars.*) (SEATTLE.)

South San Francisco, Cal., U.S.A. (*Steel ingots, small sections and bars.*) (SAN FRANCISCO.)

Sparrows Point, Md., U.S.A. (BALTIMORE.)

Steelton, Pa., U.S.A. (*Steel forgings and castings.*) (PHILADELPHIA.)

Björneborgs Jernverks Aktiebolag, Vermlands Björneborg, Sweden. (*Melting Furnaces and Forge.*) (GOTHENBURG.)

Boxholms Aktiebolag, Boxholm, Sweden. (*Steel rivet bars.*) (STOCKHOLM.)

Bradford, Kendall, Lim., Alexandria, Sydney, N.S.W. (*Steel castings.*) (SYDNEY, N.S.W.)

Britannia Mining & Smelting Co., Lim., Britannia Beach, B.C., Canada. (*Small steel castings.*) (VANCOUVER.)

Broken Hill Proprietary Co., Lim., Iron and Steel Works, Newcastle, N.S.W. (*Steel plates, bars, sections and castings.*) (NEWCASTLE, N.S.W.)

Burlington Steel Co., Lim., Hamilton, Ontario. (*Small steel sections and bars.*) (TORONTO.)

Burmeister & Wain's Maskin-og Skibsbyggeri, Aktieselskabet, Copenhagen, Denmark. (*Steel ingots, forgings and castings.*) (COPENHAGEN.)

Canada Foundries & Forgings, Lim., Welland, Ontario. (*Steel forgings.*) (TORONTO.)

Canadian Brake, Shoe & Foundry Co., Lim., Sherbrooke, Quebec, Canada. (*Steel castings.*) (MONTREAL).

Canadian Car & Foundry, Steel Foundry Division, Longue Pointe, Montreal. (*Steel castings.*) (MONTREAL.)

Canadian Tube & Steel Products, Lim., 5765, Hamilton Street, Montreal, P.Q. (*Steel angles, bars and rivets.*) (MONTREAL.)

Carnegie-Illinois Steel Corporation, Chicago, Ill., U.S.A. (CHICAGO, ILL.)

Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., U.S.A (PITTSBURGH.)

Central Iron & Steel Co., Harrisburg, Pa., U.S.A. (*Rolling Mills.*) (PHILADELPHIA.)

Christiania Spigerverk, Oslo, Norway. (*Steel ingots and bars, also rivet bars.*) (OSLO.)

Colorado Fuel & Iron Corporation, Minnequa Works, Pueblo, Colorado. (*Steel ingots, bars and small sections.*) (CHICAGO.)

Columbia Steel Company, Pittsburgh, Cal., U.S.A. (*Steel castings.*) (SAN FRANCISCO.)

Columbia Steel Company, Torrance, Cal., U.S.A. (*Round bars, sections and sheets, also steel castings.*) (LOS ANGELES.)

Commonwealth Steel Co., Lim., Waratah, Newcastle, N.S.W. (*Steel castings and forgings.*) (NEWCASTLE, N.S.W.)

Compagnie Des Forges et Aciéries de la Marine et D'Homecourt, St. Chamond (Loire), France. (PARIS.)

Companhia União Fabril, Lisbon, Portugal. (*Steel castings.*) (LISBON.)

Compañia Anonima Basconia, Bilbao, Spain. (BILBAO.)

Compañia Auxiliar de Ferrocarriles, Beasain, Guipuzcoa, Spain. (*Small steel castings and forgings.*) (BILBAO.)

Compañia Euskalduna, Talleres de Elorrietta, Bilbao, Spain. (*Steel castings.*) (BILBAO.)

Crucible Steel Castings Co., Lansdowne, Pa., U.S.A. (*Steel castings.*) (PHILADELPHIA.)

Danske, (Det), Staalvalsevaerk A/S, Frederiksvaerk, Denmark. (*Sections and bars.*) (COPENHAGEN.)

Degerfors Järnverks Aktiebolag, Degerfors, Sweden. (*Melting Furnaces and Rolling Mills.*) (GOTHENBURG.)

Dodge Steel Company, Tacony, Philadelphia, Pa., U.S.A. (*Small steel castings.*) (PHILADELPHIA.)

Dominion Bridge Co., Lim., Calgary Rolling Mill Dept., Calgary, Alberta, Canada. (*Sections and bars.*) (VANCOUVER.)

Dominion Foundries & Steel Lim., Hamilton, Ontario, (*Steel ingots, plates and castings.*) (TORONTO.)

Dominion Steel & Coal Corporation, Lim., Sydney, Nova Scotia. (*Steel ingots, billets, plates and sections.*) (HALIFAX, N.S.)

Drammens Jernstoberi & Mek. Verksted A/S, Drammen, Norway. (*Small steel castings.*) (OSLO.)

Dunswart Iron & Steel Works, Lim., Benoni, South Africa. (*Steel castings, ingots, billets and small sections.*) (PORT NATAL.)

Enterprise Engine & Foundry Co., South City, Cal., U.S.A. (*Steel castings.*) (SAN FRANCISCO.)

Erie Forge Co., Erie, Pa., U.S.A. (*Steel ingots, forgings and castings.*) (CLEVELAND, O.)

Fabrica Italiana Tubi, Società Anonima, Sestri-Levante, Italy. (*Steel ingots, billets and weldless rolled and drawn steel tubes*). (GENOA.)

Fabrica Nacional de Trubia, Trubia Asturias, Spain. (*Steel castings and forgings.*) (BILBAO.)

Fagersta Bruks Aktiebolag, Fagersta, Sweden (Brukskoncernen.)

Works at Fagersta. (*Steel blooms and billets.*)

Works at Forsbacka. (*Steel blooms, billets, tubes and forged and rolled bars.*) (STOCKHOLM.)

Works at Horndal. (*Steel bars and angles.*)

Works at Osterbybruk. (*Steel castings.*)

Falk Corporation, Milwaukee, Wis., U.S.A. (*Steel castings.*) (CLEVELAND, O.)

Finkl (A.) & Sons Company, Chicago, Ill., U.S.A. (*Steel forgings.*) (CHICAGO, ILL.)

Fonderie Acciaierie Milanesi Vanzetti, Milan. (*Steel castings*) (GENOA.)

Fonderies, Forges et Aciéries de St. Etienne, St. Etienne, France. (PARIS.)

Forges et Ateliers de Constructions Electriques de Jeumont. Jeumont (Nord), France. (*Steel castings.*) (PARIS.)

Fratelli Bruzzo-Ferriera di Bolzaneto, Genova-Bolzaneto, Italy. (*Steel plates, sections and bars.*) (GENOA.)

Fundiciones Escorsa S.A., Pi y Margall, 2- Hospitalet de Llobregat, Barcelona, Spain. (*Steel castings.*) (BARCELONA.)

General Metals Corporation (Best Plant Division), Oakland, Cal., U.S.A. (*Steel castings.*) (SAN FRANCISCO.)

General Steel Castings Corporation, Eddystone, Pa., U.S.A. (*Steel castings.*) (PHILADELPHIA.)

Geneva Steel Company (United States Steel Corp. Subsidiary), Geneva, Utah, U.S.A. (*Steel plates.*) (LOS ANGELES.)

Giovanni Villa, Società Anonima, Officine Meccaniche - Fucinati - Stampati, Milan, Italy. (*Steel forgings.*) (GENOA.)

Hadfields Steel Works, Lim., Alexandria, Sydney, N.S.W. (*Steel castings.*) (SYDNEY, N.S.W.)

Hallstahammars Aktiebolag, Hallstahammar, Sweden. (*Steel bars.*) (STOCKHOLM.)

Hellefors Bruks Aktiebolag Hållefors, Sweden. (*Steel bars.*) (GOTHENBURG.)

Helsingors Skibsvaerft-og Maskinbyggeri A/S, Aktieselskabet, Elsinore, Denmark. (*Steel ingots, forgings and castings.*) (COPENHAGEN.)

Huta Pokoj Sp.A., Katowice, Poland.

Works "Huta Pokoj" at Nowy Bytom. (GDYNIA.)

Ilva Alti Forni e Acciaierie D'Italia : *Head Office*, Genoa,

Stabilimento di Bagnoli. (*Steel ingots, sections and bars.*) (NAPLES.)

Stabilimento di Genova-Bolzaneto. (*Sections and bars.*) (GENOA.)

Stabilimento di Genova-Voltri. (*Small sections, bars and rivets.*) (GENOA.)

Stabilimento di Ilvania. (*Steel ingots, billets and plates.*) (TRIESTE.)

Stabilimento di Lovere. (*Sections, bars, castings and forgings.*) (GENOA.)

Stabilimento di Marghera. (*Steel castings, also rolling mills for small steel sections and bars.*) (TRIESTE.)

Stabilimento di Savona. (*Sections, bars and plates.*) (GENOA.)

Stabilimento di Torre Annunziata, Centrale. (*Steel ingots sections and bars.*) (NAPLES.)

Stabilimento di Porto Vecchio di Piombino. (*Steel ingots blooms, sections and bars.*)

Industrial Steels, Lim., Lidcombe, Sydney, N.S.W. (*Steel castings.*) (SYDNEY, N.S.W.)

Inland Steel Co., Indiana Harbor, Ind., U.S.A. (*Steel ingots, blooms, billets and slabs.*) (CHICAGO.)

Iscor Vanderbyl Works, Plate Division, Houlkop, nr. Vereeniging, S. Africa. (*Rolling Mills for plates.*) (PORT NATAL.)

Jones & Laughlin Steel Corporation, Pittsburgh, Pa., U.S.A. (PITTSBURGH.)

Kaiser Company, Inc., Iron & Steel Division, Fontana, Cal., U.S.A. (*Steel ingots and plates.*) (LOS ANGELES.)

Kockums Jernverk, Kallinge, Sweden. (*Steel castings.*) (MALMO.)

Kohlswa Jernverks Aktiebolag. (*Melting Furnaces, Foundry, Forge and Rolling Mills for bars and small sections* at Kolsva, Sweden.) (STOCKHOLM.)

La Maquinista Terrestre y Maritima, S.A., Barcelona. (*Steel castings and forgings.*) (BARCELONA.)

Lebanon Steel Foundry, Lebanon, Pa., U.S.A. (*Small steel castings.*) (PHILADELPHIA.)

Lukens Steel Company, Coatesville, Pa., U.S.A. (PHILADELPHIA.)

Luzuriaga, Victorio, S.L., Pasajes, Guipuzcoa, Spain. (*Steel castings.*) (BILBAO.)

Machine Fabriek Yzer-Staal & Metaal Gieterij (v/h Bakker & Co.), Ridderkerk. (*Steel castings.*) (ROTTERDAM.)

Manitoba Rolling Mill Co., Lim., Winnipeg, Manitoba, Canada. (*Steel billets, bars and sections.*) (MONTREAL.)

Manitoba Steel Foundries, Lim., Selkirk, Manitoba, Canada. (*Steel castings.*) (VANCOUVER.)

Maritime Steel Foundries, Lim., New Glasgow, Nova Scotia. (*Small steel castings.*) (HALIFAX, N.S.)

Melbourne Iron & Steel Mills Pty., Lim., Brooklyn, Melbourne, Australia. (*Steel ingots.*) (MELBOURNE.)

Mesta Machine Co., West Homestead, Pa., U.S.A. (*Steel ingots, castings and forgings.*) (PITTSBURGH.)

Midvale Company (The), Nicetown, Philadelphia, Pa., U.S.A. (*Steel forgings.*) (PHILADELPHIA.)

N.V. Machinefabriek G. Dikkers & Co., Hengelo, Holland. (*Small steel castings.*)

Nanaimo Foundry & Engineering Works, Lim., Nanaimo, B.C., Canada. (*Small steel castings.*) (VANCOUVER.)

National Enameling & Stamping Co., Granite City, Ill., U.S.A. (CLEVELAND, O.)

National Malleable and Steel Castings Co., Sharon, Pa. (*Steel ingots and steel castings.*) (CLEVELAND.)

Nederlandsche Staalfabrieken (v/h J. M. de Muinck Keizer), Utrecht, Holland. (*Steel ingots, blooms, billets and castings; also steel rivet bars.*) (ROTTERDAM.)

Newport News Shipbuilding & Dry Dock Co., Newport News, Va., U.S.A. (*Steel castings and forgings.*) (NEWPORT NEWS.)

Northwest Steel Rolling Mills, Inc., Seattle, Wash., U.S.A. (*Steel ingots, small sections and bars.*) (SEATTLE, WASH.)

Nova Scotia Steel & Coal Co., Lim. (*Rolling Mills* at New Glasgow, N.S.) (*Forgings, sections and bars.*) (HALIFAX, N.S.)

Oesterreichisch-Alane Montangesellschaft, Vienna.

Works at Donawitz, Styria. (*Plates and sections.*) (VIENNA.)

Works at Kindberg, Styria. (*Rolling Mills for small sections and bars.*) (VIENNA.)

Oliver Iron & Steel Co., Pittsburgh, Pa., U.S.A. (*Rolling Mills for bars.*) (PITTSBURGH.)

Olympic Steel Works, Seattle, Wash., U.S.A. (*Steel castings.*) (SEATTLE, WASH.)

Pacific Car & Foundry Co., Renton, Wash., U.S.A. (*Steel castings.*) (SEATTLE, WASH.)

Pacific States Steel Corporation, Niles, California, U.S.A. (*Steel ingots, sections and bars.*) (SAN FRANCISCO.)

Pacific Steel Castings Co., Berkeley, Cal., U.S.A. (*Steel castings.*) (SAN FRANCISCO.)

Penn Steel Castings Corporation, Chester, Pa., U.S.A. (*Steel castings.*) (PHILADELPHIA.)

Pennsylvania Forge Corporation, Tacony, Philadelphia, Pa., U.S.A. (*Steel forgings.*) (PHILADELPHIA.)

Phœnix Iron Company (The), Phœnixville, Pa., U.S.A. (*Sections and bars.*) (PHILADELPHIA.)

Pittsburgh Crucible Steel Co., Midland, Pa., U.S.A. (PITTSBURGH.)

Raufoss Ammunis Jonsfabrikker, Raufoss, Norway. (*Steel castings.*) (OSLO.)

"Reggiane" Officine Meccaniche Italiane S.p.A.-Reggio Emilia. (*Steel forgings.*) (GENOA.)

Reliance Foundry Co., Lim., Vancouver, B.C., Canada. (*Steel castings.*) (VANCOUVER.)

Republic Steel Corporation, Cleveland, O., U.S.A.

Alabama City, Ala., U.S.A. (MOBILE, ALA.)

Buffalo Plant, Buffalo, N.Y., U.S.A. (CLEVELAND, O.)

Central Alloy District, Massillon Plant, Massillon, O., U.S.A. (CLEVELAND, O.)

Chicago Plant, Chicago, Ill., U.S.A. (CHICAGO, ILL.) (*Steel Works* at 118th Street, Chicago, and *Rolling Mills* at East Chicago, Ind.) (*Steel angles and bars.*)

Cleveland District, Cleveland, O., U.S.A. (CLEVELAND, O.)

Corrigan McKinney Plant. (*Steel ingots, blooms and billets.*)

Upson Nut Plant. (*Round and square steel bars.*)

Youngstown Plant, Youngstown, O., U.S.A. (PITTSBURGH.)

Riverside Iron Works, Lim., Calgary, Alberta, Canada. (*Steel castings.*) (VANCOUVER.)

Roxbury Steel Casting Co., Boston, Mass., U.S.A. (*Steel castings.*) (BOSTON.)

Ruwolt (Charles) Proprietary, Lim., Richmond, Melbourne. (*Steel castings.*) (MELBOURNE.)

Sandvikens Jernverks Aktiebolag, Sandviken, Sweden. (*Steel ingots, forgings and steel tubes.*) (STOCKHOLM.)

Schneider & Co., Creusot, France. (PARIS.)

SKF. Hofors Bruk, Hofors, Sweden. (*Steel billets, bars and forgings, and thick walled tubes.*) (STOCKHOLM.)

Smedjebackens Valsverks Aktiebolaget, Smedjebacken, Sweden. (*Steel sections and castings.*) (STOCKHOLM.)

Sociedad Altos Hornos de Vizcaya, Bilbao. (BILBAO.)

Sociedad Anonima Echevarria, Bilbao. (*Small sections and bars.*) (BILBAO.)

Sociedad Anonima Industrial Asturiana, Fabricas de Moreda y Gijon, Gijon. (*Rivet bars.*) (BILBAO.)

Sociedad Anonima Industrias Mecanicas, Barcelona, Spain. (*Steel castings.*) (BARCELONA.)

Sociedad Anonima Jose Maria Quijano, Forjas de Los Corrales de Buelna, Provincia de Santander, Spain. (*Steel bars.*) (BILBAO.)

Sociedad Anonima Talleres de Deusto, Deusto, Bilbao. (*Steel castings.*) (BILBAO.)

Sociedad Española de Construccion Naval. *Works* at Reinosa, near Santander, Spain. (*Steel ingots, forgings, castings, plates, and sections.*) (BILBAO.)

Works at Sestao, near Bilbao, Spain. (*Small steel castings, ingots and forgings.*) (BILBAO.)

Sociedad Metalurgica Duro-Felguera, La Felguera, Asturias, Spain. (*Steel ingots, billets, castings, plates and sections.*) (BILBAO.)

Società Anonima Acciaierie Elettriche di Sesto San Giovanni, Sesto San Giovanni, Milan, Italy. (*Steel castings.*) (GENOA.)

Società Anonima Fonderie Acciaierie Liguri, Genova-Sampierdarena. (*Small steel castings.*) (GENOA.)

Società Anonima Fonderie Officine di Gorizia, Gorizia, Italy. (*Small steel castings.*) (TRIESTE.)

Società Anonima Nazionale "Cogne" (*Head Office*, Turin: *Works* at Aosta.) (*Steel ingots, forgings, plates, sections and bars.*) (GENOA.)

Società Italiana Acciaierie Cornigliano (*Head Office* and *Works* at Genova-Cornigliano.) (*Steel ingots, forgings, castings, plates and sections.*) (GENOA.)

Società Italiana Ernesto Breda Sesto S. Giovanni, Milan, Italy. (*Steel ingots, sections, forgings and steel castings.*) (GENOA.)

Società per Azioni Acciaierie di Bolzano, Bolzano, Italy. (*Steel ingots, billets, rolled bars, forgings and steel castings.*) (GENOA.)

Società per Azioni FIAT-Sezione Ferriere Piemontesi, Turin, Italy. (*Steel ingots, plates, sections, also seamless and welded tubes.*) (GENOA.)

Società per Azioni FIAT-Sezione Industrie Metallurgiche Acciaierie, Turin, Italy. (*Steel castings and forgings.*) (GENOA.)

Société Anonyme d'Escaut & Meuse, Anzin (Nord), France. (*Steel ingots and weldless rolled or drawn steel tubes.*) (PARIS.)

Société Anonyme de la Fabrique de Fer de Charleroi, Charleroi, Belgium. (*Steel ingots and plates.*) (ANTWERP.)

Société Anonyme de la Fabrique de Fer de Mauberge, Louvroil (Nord), France. (*Steel ingots and plates.*) (PARIS.)

Société Anonyme des Aciéries ci-devant Georges Fischer, Schaffhouse, Switzerland. (*Steel castings.*) (WINTERTHUR.)

Société Anonyme des Etablissements Marrel Freres Usine, des Etaings, near Rive-de-Gier (Loire), France.

Société Anonyme des Forges de la Providence, Marchienne-au-Pont, Belgium. (*Sections and* bars.) (ANTWERP.)

Société Anonyme des Forges de Vireux-Molhain, Vireux Molhain, Ardennes, France. (*Plates, bars and sections.*) (ANTWERP.)

Société Anonyme des Forges et Aciéries de Denain et d'Anzin, Denain (Nord), France. (*Steel ingots, plates, sections and steel castings.*) (PARIS.)

Société Anonyme des Forges et Aciéries du Nord et de l'Est, France. *Works* at Hautmont. (*Steel ingots and plates.*) (PARIS.)

Works at Valenciennes. (*Steel ingots, forgings, blooms, bars and sections.*) (PARIS.)

Société Anonyme des Forges et Laminoirs de Baume, Haine St. Pierre, Belgium. (*Rolling Mills for bars and sections.*) (ANTWERP.)

Société Anonyme des Forges, Usines & Fonderies de Haine St. Pierre, Haine St. Pierre, Belgium. (*Steel castings.*) (ANTWERP.)

Société Anonyme des Hauts-Fourneaux, Forges et Aciéries de Pompey, Usines de Pompey, France. (*Steel ingots, plates, angles and round bars.*) (PARIS.)

Société Anonyme des Laminoirs Hauts-Fourneaux, Forges & Fonderies de la Providence, Hautmont (Nord), France (*Steel ingots, plates and sections.*) (PARIS.)

Société Anonyme des Usines Gilson, La Croyère (Bois d'Haine), Belgium. (*Steel ingots, blooms, sections and rivet bars.*) (ANTWERP.)

Société Anonyme d'Ougrée-Marihaye, Ougrée, near Liége, Belgium. (ANTWERP.)

Société Anonyme John Cockerill. (*Works* at Seraing, Belgium.) (*Works* at Grivegnée.) (*Steel ingots and bars.*) (ANTWERP.)

Société Anonyme La Brugeoise et Nicaise & Delcuve, St, Michel-lez-Bruges, Belgium. (*Steel ingots and castings.*) (ANTWERP.)

Société Anonyme Louvroil Montbard, Aulnoye (Nord), France. (*Weldless rolled or drawn steel tubes.*) (PARIS.)

Société Anonyme Usines & Aciéries Leonard-Giot, Marchienne-au-Pont, Belgium. (*Steel castings.*) (ANTWERP.)

Société Anonyme Usines Metallurgiques du Hainaut, Couillet, Belgium. (*Steel forgings, castings, bars and sections.*) (ANTWERP.)

Société des Aciéries de Longwy, Mont St. Martin (Meurthe & Moselle), France. (PARIS.)

Société des Usines de Louis de Roll, Gerlafingen, Switzerland. (*Steel ingots, round bars, and forgings.*) (WINTERTHUR.)

Sorel Industries, Lim., Sorel, P.Q., Canada. (*Steel ingots and forgings.*) (MONTREAL.)

Sorel Steel Foundries Lim., Sorel, P.Q., Canada. (*Steel castings.*) (MONTREAL.)

South African Iron & Steel Industrial Corporation, Lim., "Iscor" *Works* at Pretoria Transvaal, S. Africa. (*Steel ingots, billets, sections and thin plates up to* $\frac{3}{8}$ *in. thick.*) (CAPETOWN.)

Stabilimenti di Dalmine, Società Anonima, Dalmine (Bergamo), Italy. (*Weldless rolled or drawn steel tubes, hollow pillars and davits.*) (GENOA.)

Standard Steel Works Co., Burnham, Mifflin County, Pa., U.S.A. (*Steel castings and forgings.*) (PHILADELPHIA.)

Stavanger Electro-Staalverk A.S., Stavanger, Norway. (*Steel castings.*) (BERGEN.)

Steel Company of Australia, Coburg, Melbourne. (*Steel castings.*) (MELBOURNE.)

Steel Company of Canada, Hamilton, Ontario. *Works* at Hamilton. (TORONTO.) *Works* at Montreal. (*Bars and angles, steel plates and billets.*) (MONTREAL.)

Stora Kopparbergs Bergslags Aktiebolag, Falun, Sweden. (*Steel Works* at Domnarfvet.) (*Sections of all sizes and plates up to* $1\frac{1}{4}$ *ins. thick; steel castings.*) (STOCKHOLM.)

Strömmens Verksted, near Oslo, Norway. (*Steel castings.*) (OSLO.)

Sucesora de Aceros Electricos S.A., Barcelona, Spain. (*Steel castings.*) (BARCELONA.)

Sulzer Frères, Société Anonyme, Winterthur, Switzerland. (*Steel castings.*) (WINTERTHUR.)

Surahammars Bruks Aktiebolag, Surahammar, Sweden, (*Forge and Rolling Mills, also steel castings.*) (STOCKHOLM.)

Tata Iron & Steel Co., Lim., Jamshedpur, India. (*Steel plates, angles and channels.*) (CALCUTTA.)

Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., U.S.A. (*Steel Works* at Ensley, Ala., and *Rolling Mills, also forgings*, at Bessemer and Fairfield, Ala.) (MOBILE.)

"Terni" Società per l'Industria e l'Elettricità (*Works* at Terni.) (*Steel ingots, forgings, castings and plates.*) (GENOA.)

Thompson's Engineering & Pipe Co., Lim., Williamstown, Victoria. (*Steel castings.*) (MELBOURNE.)

Tosi (Franco), Legnano, Italy. (*Steel forgings and castings.*) (GENOA.)

Travaux Metalliques de Boom, Société Anonyme, Boom, Belgium. (*Small steel castings.*) (ANTWERP.)

Uddeholms Aktiebolag, Uddeholm, Sweden. Nykroppa, Sweden. (*Steel ingots, forgings and bars.*) Storfors, Sweden. (*Weldless steel tubes*) and Hagfors, Sweden. (*Steel castings.*) (GOTHENBURG.)

Union des Aciéries, Société Anonyme, Marcinelle, Charleroi, Belgium. (*Steel castings.*) (ANTWERP.)

Union Steel Corporation of (South Africa), Ld. "Usco" *Steel Works and* "Saban" *Rivet Works* at Vereeniging, Transvaal, South Africa. (*Steel ingots, billets, small sections, also steel castings.*) (CAPE TOWN.)

Usines & Aciéries Allard, Société Anonyme, Mont-sur-Marchienne, near Charleroi, Belgium. (*Steel castings.*) (ANTWERP.)

Usines & Acieries Allard, Société Anonyme, Turnhout, Belgium. (*Small steel castings.*) (ANTWERP.)

Usines Emile Henricot, Court St. Etienne, Belgium. (*Steel castings.*) (ANTWERP.)

Usines Gustave Boël (Aciéries de la Louvière), La Louvière, Belgium. (*Steel ingots, forgings, castings, plates and bars.*) (ANTWERP.)

Vancouver Engineering Works, Lim., Vancouver, B.C. (*Steel castings.*) (VANCOUVER, B.C.)

Varde Staalvaerk, Varde, Denmark. (*Steel ingots and castings.*) (COPENHAGEN.)

Victoria Machinery Depot Co., Lim., Victoria, B.C., Canada. (*Steel castings.*) (VANCOUVER.)

Vulcan Iron Works, Lim., Winnipeg, Manitoba, Canada (*Steel castings.*) (VANCOUVER.)

Warman (The), Steel Casting Co., Los Angeles, Cal., U.S.A. (*Steel castings.*) (LOS ANGELES.)

Washington Iron Works, Seattle, Wash., U.S.A. (*Steel castings.*) (SEATTLE.)

Wendel, Les Petits Fils de Fois de, Usine "Fenderie", Hayange, Moselle, France. (PARIS.)

Westland Steel Foundry Lim., Vancouver, B.C., Canada. (*Steel castings.*) (VANCOUVER.)

Wheeling Steel Corporation, La Belle Works, Steubenville, O., U.S.A. (PITTSBURGH.)

Worth Steel Co., Claymont, Del., U.S.A. (*Steel plates.*) (PHILADELPHIA.)

Youngstown (The) Sheet & Tube Co., Youngstown, O., U.S.A. (PITTSBURGH.)

Zelezarna Jesenice, Jesenice, Yugoslavia. (SPLIT.)

FIRMS IN COUNTRIES OTHER THAN GREAT BRITAIN AND IRELAND.

ARRANGED ACCORDING TO SURVEYING DISTRICTS.

All steel works in Germany and Japan which were on the approved list before the war have been omitted from the list which follows.

In countries which were occupied by forces from these nations, information regarding the steel works is still incomplete and names of the works have only been included if inspection has been carried out since the war.

AMSTERDAM.

N.V. Machinefabriek G. Dikkers & Co., Hengelo, Holland. (*Small steel castings.*)

ANTWERP.

Aciéries de Haine St. Pierre et Lesquin, Société Anonyme, Haine St. Pierre. (*Steel castings.*)

Aciéries & Minières de la Sambre,

Works at Monceau-sur-Sambre. (*Rolling Mills for bars.*)

Works at Nimy. (*Rolling Mills for bars.*)

Société Anonyme de la Fabrique de Fer de Charleroi, Charleroi. (*Steel ingots and plates.*)

Société Anonyme d'Ougrée-Marihaye, Ougrée, near Liége.

Société Anonyme des Forges de la Providence, Marchienne-au-Pont, Belgium. (*Sections and bars.*)

Société Anonyme des Forges, de Vireux-Molhain, Vireux-Molhain, Ardennes, France. (*Plates, bars and sections.*)

Société Anonyme des Forges et Laminoirs de Baume, Haine St. Pierre. (*Rolling Mills for bars and sections.*)

Société Anonyme des Forges, Usines & Fonderies de Haine St. Pierre, Haine St. Pierre. (*Steel castings.*)

Société Anonyme des Usines Gilson, La Croyère (Bois d'Haine.) (*Steel ingots, blooms, sections, and rivet bars.*)

Société Anonyme Usines Metallurgiques du Hainaut, Couillet. (*Steel forgings, castings, bars and sections.*)

Société Anonyme John Cockerill.

Works at Seraing.

Works at Grivegnée. (*Steel ingots and plates.*)

Société Anonyme La Brugeoise et Nicaise & Delcuve, St. Michel-lez-Bruges. (*Steel ingots and castings.*)

Société Anonyme Usines & Aciéries Leonard-Giot, Marchienne-au-Pont. (*Steel castings.*)

Travaux Metalliques de Boom, Société Anonyme, Boom. (*Small steel castings.*)

Union des Aciéries, Société Anonyme, Marcinelle, Charleroi. (*Steel castings.*)

ANTWERP—*continued.*

Usines & Aciéries Allard, Société Anonyme, Mont-sur-Marchienne, near Charleroi. (*Steel castings.*)

Usines & Aciéries Allard, Société Anonyme, Turnhout, (*Small steel castings.*)

Usines Emile Henricot, Court St. Etienne. (*Steel castings.*)

Usines Gustave Boël (Aciéries de la Louvière), La Louvière. (*Steel ingots, forgings, castings, plates and bars.*)

BALTIMORE, MD.

Bethlehem Steel Co., Sparrows Point, Md., U.S.A.

BARCELONA.

Altos Hornos de Viscaya, S.A., Fabrica de Sagunto, Sagunto, Spain. (*Steel ingots, bars and sections.*)

Fundiciones Escorsa S.A., Pi y Margall, 2-Hospitalet de Llobregat, Barcelona, Spain. (*Steel castings.*)

La Maquinista Terrestre y Maritima S.A., Barcelona, Spain. (*Steel castings and forgings.*)

Sociedad Anonima Industrias Mecanicas, Barcelona, Spain. (*Steel castings.*)

Sucesora de Aceros Electricos S.A., Barcelona, Spain. (*Steel castings.*)

BERGEN.

Stavanger Electro-Staalwerk A.S., Stavanger, Norway. (*Steel castings.*)

BILBAO.

Compañia Anonima Basconia, Bilbao, Spain.

Compañia Auxiliar de Ferrocarriles, Beasain, Guipuzcoa, Spain. (*Small steel castings and forgings.*)

Compañia Euskalduna, Talleres de Elorrietta, Bilbao, Spain. (*Steel castings.*)

Fabrica Nacional de Trubia, Trubia Asturias, Spain. (*Steel castings and forgings.*)

Luzuriaga, Victorio, S.L., Pasajes, Guipuzcoa, Spain. (*Steel castings.*)

Sociedad Altos Hornos de Vizcaya, Bilbao, Spain.

Sociedad Anonima Echevarria, Bilbao, Spain. (*Small sections and bars.*)

BILBAO—*continued.*

Sociedad Anonima Industrial Asturiana, Fabricas de Moreda y Gijon, Gijon, Spain. (*Rivet bars.*)

Sociedad Anonima Jose Maria Quijano, Forjas de Los Corrales de Buelna, Provincia de Santander, Spain. (*Steel bars.*)

Sociedad Anonima Talleres de Deusto, Deusto, Bilbao, Spain. (*Steel castings.*)

Sociedad Española de Construccion Naval. *Works* at Reinosa, near Santander, Spain. (*Steel ingots, forgings, castings, plates and sections.*)

Works at Sestao, near Bilbao. (*Small steel castings, ingots and forgings.*)

Sociedad Metalurgica Duro-Felguera, La Felguera, Asturias, Spain. (*Steel ingots, billets, castings, plates and sections.*)

BOSTON.

Roxbury Steel Casting Co., Boston, Mass., U.S.A. (*Steel castings.*)

CALCUTTA.

Bengal Steel Corporation, Burnpur, India. (*Sections and angles.*)

Tata Iron & Steel Co., Lim., Jamshedpur, India. (*Steel plates, angles and channels.*)

CAPETOWN.

South African Iron & Steel Industrial Corporation, Lim., "Iscor" *Works* at Pretoria, Transvaal, S. Africa. (*Steel ingots, billets, sections and thin plates up to $\frac{3}{8}$ in. thick.*)

Union Steel Corporation of (South Africa), Lim., "Usco" Steel Works and "Saban" Rivet *Works* at Vereeniging, Transvaal, S. Africa. (*Steel ingots, billets, small sections, also steel castings.*)

CHICAGO, ILL.

Carnegie-Illinois Steel Corporation, Chicago, Ill., U.S.A.

Colorado Fuel & Iron Corporation, Minnequa Works, Pueblo, Colorado, U.S.A. (*Steel ingots, bars and small sections.*)

Finkl (A.) & Sons Company, Chicago, Ill., U.S.A. (*Steel forgings.*)

Inland Steel Co., Indiana Harbor, Ind., U.S.A. (*Steel ingots, blooms, billets and slabs.*)

Republic Steel Corporation, Cleveland, O., U.S.A.

Chicago Plant, Chicago, Ill., U.S.A. *Steel Works* at 118th Street, Chicago, and *Rolling Mills* at East Chicago, Ind. (*Steel angles and bars.*)

CLEVELAND, O.

American Rolling Mill Co., Middletown, O., U.S.A. (*Steel castings and forgings.*)

CLEVELAND, O.—*continued.*

Bethlehem Steel Co., Buffalo, N.Y., U.S.A.

Erie Forge Co., Erie, Pa., U.S.A. (*Steel ingots, forgings and castings.*)

Falk Corporation, Milwaukee, Wis., U.S.A. (*Steel castings.*)

National Enameling & Stamping Co., Granite City, Ill., U.S.A.

National Malleable and Steel Castings Co., Sharon, Pa., U.S.A. (*Steel ingots and steel castings.*)

Republic Steel Corporation, Cleveland, O., U.S.A.

Buffalo Plant, Buffalo, N.Y., U.S.A.

Central Alloy District, Massillon Plant, Massillon, O., U.S.A.

Cleveland District, Cleveland, O., U.S.A.

Corrigan McKinney Plant. (*Steel ingots, blooms and billets.*)

Upson Nut Plant. (*Round and square steel bars.*)

COPENHAGEN.

Burmeister & Wain's Maskin-og Skibsbyggeri, Aktieselskabet, Copenhagen, Denmark. (*Steel ingots, forgings and castings.*)

Danske, (Det), Staalvalsevaerk A/S., Frederiksvaerk, Denmark. (*Sections and bars.*)

Helsingør Skibsvaerft-og Maskinbyggeri A/S., Aktieselskabet, Elsinore, Denmark. (*Steel ingots, forgings and castings.*)

Varde Staalvaerk, Varde, Denmark. (*Steel ingots and castings.*)

GDYNIA.

Huta Pokoj Sp. A., Katowice, Poland.

Works at Nowy Bytom.

GENOA.

A.S.S.A. Acciaierie di Susa Società Anonima, Torin, Italy. *Head Office* at Turin. *Works* at Susa. (*Steel castings.*)

Acciaieria e Tubificio di Brescia, Società Anonima, Brescia. (*Steel ingots, sections and bars, steel castings, weldless or water gas welded tubular materials.*)

Acciaieria e Ferriera del Caleotto - Società Anonima, Lecco, Italy. (*Steel ingots, bars, small sections and small forgings.*)

Acciaierie Elettriche Pio Faggian, La Spezia, La Spezia. (*Small steel castings.*)

Acciaierie e Ferriere Lombarde Falck. *Head Office* Milan. *Works* at Milan. (*Weldless rolled or drawn steel tubes.*)

Unione *Works* at Sesto S. Giovanni. (*Steel ingots, sections, bars, forgings, also steel castings.*)

GENOA—*continued.*

Ansaldo Societa Anonima, Stabilimento Fossati, Genoa-Sestri. (*Steel forgings.*)

Fabrica Italiana Tubi, Società Anonima, Sestri Levante, Italy. (*Steel ingots, billets and weldless rolled and drawn steel tubes.*)

Fonderie Acciaierie Milanesi Vanzetti, Milan. (*Steel castings.*)

Fratelli Bruzzo-Ferriera di Bolzaneto, Genova-Bolzaneto (*Steel plates, sections and bars.*)

Giovanni Villa - Società Anonima Officine Meccaniche - Fucinati - Stampati, Milan. (*Steel forgings.*)

"Ilva" Alti Forni e Acciaierie d'Italia: *Head Office*, Genoa.

Stabilimento di Genova-Bolzaneto. (*Sections and bars.*)

Stabilimento di Genova-Voltri. (*Small sections, bars and rivets.*)

Stabilimento di Lovere. (*Sections, bars, castings and forgings.*)

Stabilimento di Novi Ligure. (*Sections, bars and plates.*)

Stabilimento di Porto Vecchio di Piombino. (*Steel ingots, blooms, sections and bars.*)

Stabilimento di Savona. (*Sections, bars and plates.*)

"Reggiane" Officine Meccaniche Italiane S.p.A.-Reggio Emilia. (*Steel forgings.*)

Società Anonima Acciaierie Cornigliano (*Head Office* at Genova-Cornigliano.) (*Steel ingots, sections, forgings and steel castings.*)

Società Anonima Acciaierie Elettriche di Sesto San Giovanni, Sesto San Giovanni, Milan. (*Steel castings.*)

Società Anonima Fonderie Acciaierie Liguri, Genova-Sampierdarena. (*Small steel castings.*)

Società Anonima Nazionale "Cogne" (*Head Office*, Turin: *Works* at Aosta.) (*Steel ingots, forgings, plates, sections and bars.*)

Società Italiana Ernesto Breda Sesto S. Giovanni, Milan. (*Steel ingots, sections, forgings and steel castings.*)

Società per Azioni Acciaierie di Bolzano, Bolzano. (*Steel ingots, billets, rolled bars, forgings and steel castings.*)

Società per Azioni FIAT-Sezione Ferriere Piemontesi, Turin. (*Steel ingots, plates, sections, also seamless and welded tubes.*)

Società per Azioni FIAT-Sezione Industrie Metallurgiche Acciaierie, Turin. (*Steel castings and forgings.*)

Stabilimenti di Dalmine, Società Anonima, Dalmine (Bergamo.) (*Weldless rolled or drawn steel tubes, hollow pillars and davits.*)

"Terni" Società per l'Industria e l'Elettricita (*Works* at Terni). (*Steel ingots, forgings, castings and plates.*)

Tosi (Franco), Legnano, Italy. (*Steel forgings and castings.*)

GOTHENBURG.

Aktiebolaget Bofors, Bofors, Sweden. (*Melting Furnaces and Foundry* at Bofors.)

GOTHENBURG—*continued.*

Aktiebolaget Motala Verkstad, Motala Verkstad. Sweden. (*Melting Furnaces, Rolling Mills and Forge; also steel castings.*)

Björneborgs Jernverks Aktiebolag, Vermlands Björneborg, Sweden. (*Melting Furnaces and Forge.*)

Degerfors Järnverks Aktiebolag, Degerfors, Sweden (*Melting Furnaces and Rolling Mills.*)

Hellefors Bruks Aktiebolag, Hållefors, Sweden. (*Steel bars.*)

Uddeholms Aktiebolag, Uddeholm, Sweden. Nykroppa, Sweden. (*Steel ingots, forgings and bars.*) Storfors, Sweden. (*Weldless steel tubes.*) Hagfors, Sweden. (*Steel castings.*)

HALIFAX, N.S.

Dominion Steel & Coal Corporation Lim., Sydney, Nova Scotia. (*Steel ingots, billets, plates and sections.*)

Maritime Steel Foundries, Lim., New Glasgow, Nova Scotia. (*Small steel castings.*)

Nova Scotia Steel & Coal Co., Lim. (*Rolling Mills* at New Glasgow, Nova Scotia.) (*Forgings, sections and bars.*)

LISBON.

Companhia União Fabril, Lisbon, Portugal. (*Steel castings.*)

LOS ANGELES.

Bethlehem Pacific Coast Steel Corporation, Los Angeles 54, Cal., U.S.A. (*Round bars.*)

Columbia Steel Company, Torrance, Cal., U.S.A. (*Round bars, sections and sheets, also steel castings.*)

Geneva Steel Company (United States Steel Corp., Subsidiary.) Geneva, Utah, U.S.A. (*Steel plates.*)

Kaiser Company, Inc., Iron and Steel Division, Fontana, Cal. (*Steel ingots and plates.*)

Warman Steel Casting Co., Los Angeles, Cal., U.S.A. (*Steel castings.*)

MALMÖ.

Aktiebolaget Abjörn Anderson, Svedala, near Malmö, Sweden. (*Steel castings.*)

Kockums Jernverk, Kallinge, Sweden. (*Steel castings.*)

MELBOURNE.

Melbourne Iron and Steel Mills Pty., Lim., Brooklyn, Melbourne. (*Steel ingots.*)

Ruwolt (Charles) Proprietary, Lim., Richmond, Melbourne. (*Steel castings.*)

Steel Company of Australia, Coburg, Melbourne. (*Steel castings.*)

Thompson's Engineering & Pipe Co., Lim., Williamstown, Victoria. (*Steel castings.*)

MOBILE, ALA.

Republic Steel Corporation, Alabama City, Alabama, U.S.A.

Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., U.S.A. (*Steel Works* at Ensley, Ala., and *Rolling Mills, also forgings*, at Bessemer and Fairfield, Ala.)

MONTREAL.

Canadian Brake, Shoe & Foundry Co., Lim., Sherbrooke, Quebec, Canada. (*Steel castings.*)

Canadian Car and Foundry, Steel Foundry Division, Longue Pointe, Montreal, Canada. (*Steel castings.*)

Canadian Tube and Steel Products, Lim., 5765, Hamilton Street, Montreal, P.Q., Canada. (*Steel angles, bars and rivets.*)

Manitoba Rolling Mill Co., Lim., Winnipeg, Manitoba, Canada. (*Steel billets, bars and sections.*)

Sorel Industries, Lim., Sorel, P.Q., Canada. (*Steel ingots and forgings.*)

Sorel Steel Foundries, Lim., Sorel, P.Q., Canada. (*Steel castings.*)

Steel Company of Canada, Hamilton, Ontario, Canada. *Works* at Montreal. (*Bars and angles, steel plates and billets.*)

NAPLES.

"Ilva Alti Forni e Acciaierie d'Italia: *Head Office*, Genoa.

Stabilimento di Bagnoli. (*Steel ingots, sections and bars.*)

Stabilimento di Torre Annunziata, Centrale. (*Steel ingots, sections and bars.*)

NEW YORK.

American Steel Foundries, Newark, N.J., U.S.A. (*Steel castings.*)

NEWCASTLE, N.S.W.

Broken Hill Proprietary Co., Lim., Iron and Steel Works, Newcastle, N.S.W. (*Steel plates, bars, sections and castings.*)

Commonwealth Steel Co., Lim., Waratah, Newcastle, N.S.W. (*Steel castings and forgings.*)

NEWPORT NEWS, VA.

Newport News Shipbuilding & Dry Dock Co., Newport News, Va., U.S.A. (*Steel castings and forgings.*)

OSLO.

Christiania Spigerverk, Oslo. (*Steel ingots and bars, also rivet bars.*)

Drammens Jernstoberi & Mekverksted A/S., Drammen. (*Small steel castings.*)

Raufoss Ammunisjonsfabrikker, Raufoss. (*Steel castings.*)

Strömmens Verksted, near Oslo. (*Steel castings.*)

PARIS.

Aciéries et Ateliers de Grosse Forge, Maurice Dembiermont & Cie., Hautmont (Nord). (*Steel forgings.*)

Compagnie des Forges et Aciéries de la Marine et d'Homecourt, St. Chamond (Loire.)

Fonderies, Forges et Aciéries de St. Etienne, St. Etienne.

Forges et Ateliers de Constructions Electriques de Jeumont, Jeumont (Nord). (*Steel castings.*)

Schneider & Co., Creusot.

Société Anonyme d'Escaut & Meuse, Anzin (Nord). (*Steel ingots and weldless rolled or drawn steel tubes.*)

Société Anonyme de la Fabrique de Fer de Mauberge, Louvroil (Nord). (*Steel ingots and plates.*)

Société Anonyme des Etablissements Marrel Freres, Usine des Etaings, near Rive-de-Gier.

Société Anonyme des Forges et Aciéries du Nord et de l'Est.

Works at Hautmont. (*Steel ingots and plates.*)

Works at Valenciennes. (*Steel ingots, forgings, blooms, bars and sections.*)

Société Anonyme des Forges et Aciéries de Denain et d'Anzin, Denain (Nord). (*Steel ingots, plates, sections and steel castings.*)

Société Anonyme des Hauts-Fourneaux, Forges et Acieries de Pompey, Usines de Pompey. (*Steel ingots, plates, angles and round bars.*)

Société Anonyme des Laminoirs Hauts-Fourneaux, Forges & Fonderies de la Providence, Hautmont (Nord). (*Steel ingots, plates and sections.*)

Société Anonyme Louvroil Montbard, Aulnoye (Nord). (*Weldless rolled or drawn steel tubes.*)

Société des Aciéries de Longwy, Mont St. Martin (Meurthe & Moselle.)

Wendel, les Petits Fils de Fois de, Usine "Fenderie", Hayange, Moselle.

PHILADELPHIA, PA.

Alan Wood Steel Company, Conshohocken and Ivy Rock, Pa., U.S.A. (*Blooms, billets and thin plates.*)

Atlantic Steel Castings Co., Chester, Pa., U.S.A. (*Steel castings.*)

Bethlehem Steel Co., Bethlehem, Pa., U.S.A. (*Steel ingots, forgings, bars and sections.*)

Lebanon, Pa., U.S.A. (*Rolling Mills for bars.*)

Steelton, Pa., U.S.A. (*Steel forgings and castings.*)

Central Iron & Steel Co., Harrisburg, Pa., U.S.A. (*Rolling Mills.*)

Crucible, Steel Castings Co., Lansdowne, Pa., U.S.A. (*Steel castings.*)

Dodge Steel Company, Tacony, Philadelphia, Pa., U.S.A. (*Small steel castings.*)

General Steel Castings Corporation, Eddystone, Pa., U.S.A. (*Steel castings.*)

PHILADELPHIA, PA.—*continued.*

Lebanon Steel Foundry, Lebanon, Pa., U.S.A. (*Small steel castings.*)

Lukens Steel Company, Coatesville, Pa., U.S.A.

Midvale Company (The), Nicetown, Philadelphia, Pa., U.S.A. (*Steel forgings.*)

Penn Steel Castings Corporation, Chester, Pa., U.S.A. (*Steel castings.*)

Pennsylvania Forge Corporation, Tacony, Philadelphia, Pa., U.S.A. (*Steel forgings.*)

Phœnix Iron Company (The), Phœnixville, Pa., U.S.A. (*Sections and bars.*)

Standard Steel Works Co., Burnham, Mifflin County, Pa., U.S.A. (*Steel castings and forgings.*)

Worth Steel Co., Claymont, Del., U.S.A. (*Steel plates.*)

PITTSBURGH, PA.

Allegheny Steel Company, Brackenridge, Pa., U.S.A. (*Also steel castings.*)

American Locomotive Co., Railway Steel Spring Division. Latrobe, Pa., U.S.A. (*Steel ingots.*)

Bethlehem Steel Co., Cambria Works, Johnstown, Pa., U.S.A.

Carnegie-Illinois Steel Corporation, Pittsburgh, Pa. U.S.A.

Jones & Laughlin Steel Corporation, Pittsburgh, Pa., U.S.A.

Mesta Machine Co., West Homestead, Pa., U.S.A. (*Steel ingots, castings and forgings.*)

Oliver Iron & Steel Co., Pittsburgh, Pa., U.S.A. (*Rolling Mills for bars.*)

Pittsburgh Crucible Steel Co., Midland, Pa., U.S.A.

Republic Steel Corporation, Cleveland, O., U.S.A.; Youngstown Plant, Youngstown, O., U.S.A.

Wheeling Steel Corporation, La Belle Works, Steubenville, O., U.S.A.

Youngstown (The) Sheet & Tube Co., Youngstown, O., U.S.A.

PORT NATAL.

Dunswart Iron & Steel Works, Lim., Benoni, South Africa. (*Steel castings, ingots, billets & small sections.*)

Iscor Vanderbyl Works, Plate Division, Houlkop, near Vereeniging, South Africa. (*Rolling Mills for plates.*)

ROTTERDAM.

Machine Fabriek Yzer-Staal & Metaal Gieterij (v/h Bakker & Co.), Ridderkerk. (*Steel castings.*)

Nederlandsche Staalfabrieken (v/h J. M. Muinch Keizer), Utrecht, Holland. (*Steel ingots, blooms, billets and castings; also steel rivet bars.*)

SAN FRANCISCO, CAL.

Bethlehem Steel Corporation, South San Francisco, Cal., U.S.A. (*Steel ingots, small sections, and bars.*)

Columbia Steel Company, Pittsburgh, Cal., U.S.A. (*Steel castings.*)

Enterprise Engine & Foundry Co., South City, Cal., U.S.A. (*Steel castings.*)

General Metals Corporation (Best Plant Division), Oakland, Cal., U.S.A. (*Steel castings.*)

Pacific States Steel Corporation, Niles, Cal., U.S.A. (*Steel ingots, sections and bars.*)

Pacific Steel Castings Co., Berkeley, Cal., U.S.A. (*Steel castings.*)

SEATTLE, WASH.

Olympic Steel Works, Seattle, Wash., U.S.A. (*Steel castings.*)

Bethlehem Steel Corporation, Seattle, Wash., U.S.A. (*Sections and bars.*)

Northwest Steel Rolling Mills Inc., Seattle, Wash., U.S.A. (*Steel ingots, small sections and bars.*)

Pacific Car & Foundry Co., Renton, Wash., U.S.A. (*Steel castings.*)

Washington Iron Works, Seattle, Wash., U.S.A. (*Steel castings.*)

SPLIT

Zelezarna Jesenice, Jesenice, Yugoslavia.

STOCKHOLM.

Aktiebolaget Kanthal, Hallstahammar, Sweden. (*Steel castings.*)

Aktiebolag Svenska Jarnvagsverkstaderna, Linkoping, Sweden. (*Steel castings.*)

Avesta Jernverks Aktiebolag, Avesta, Sweden. (*Steel plates, sections and castings; also high pressure air receivers.*)

Boxholms Aktiebolag, Boxholm, Sweden. (*Steel rivet bars.*)

Fagersta Bruks Aktiebolag, Fagersta, Sweden (Brukskoncernen).

Works at Fagersta. (*Steel blooms and billets.*)

Works at Forsbacka. (*Steel blooms, billets, tubes and forged and rolled bars.*)

Works at Horndal. (*Steel bars and angles.*)

Works at Osterbybruk. (*Steel castings.*)

Hallstahammars Aktiebolag, Hallstahammar, Sweden. (*Steel bars.*)

Kohlswa Jernverks Aktiebolag. (*Melting Furnaces Foundry, Forge and Rolling Mills for bars and small sections* at Kolsva, Sweden.)

SKF. Hofors Bruk, Hofors, Sweden. (*Steel billets, bars and forgings and thick walled tubes.*)

STOCKHOLM—*continued.*

Sandvikens Jernverks Aktiebolag, Sandviken, Sweden. (*Steel ingots, forgings, and steel tubes.*)

Smedjebackens Valsverks Aktiebolaget, Smedjebacken, Sweden. (*Steel sections and castings.*)

Stora Kopparbergs Bergslags Aktiebolag, Falun, Sweden. (*Steel Works* at Domnarfvet.) (*Sections of all sizes and plates up to* $1\frac{1}{4}$ *ins. thick; steel castings.*)

Surahammars Bruks Aktiebolag, Surahammar, Sweden. (*Forge and Rolling Mills, also steel castings.*)

SYDNEY, N.S.W.

Australian Iron & Steel, Lim., Port Kembla, N.S.W. (*Steel plates, bars, sections and forgings.*)

Bradford, Kendall, Lim., Alexandria, Sydney, N.S.W. (*Steel castings.*)

Hadfields Steel Works Lim., Alexandria, Sydney, N.S.W. (*Steel castings.*)

Industrial Steels Lim., Lidcombe, Sydney, N.S.W. (*Steel castings.*)

TORONTO, ONTARIO.

Algoma Steel Corporation, Lim., Sault St. Marie, Ontario, Canada. (*Steel billets, bars and angles.*)

Atlas Steels Lim., Welland, Ontario, Canada. (*Steel ingots and bars.*)

Burlington Steel Co., Lim., Hamilton, Ontario, Canada. (*Small steel sections and bars.*)

Canada Foundries & Forgings, Lim., Welland, Ontario, Canada. (*Steel forgings.*)

Dominion Foundries & Steel, Lim., Hamilton, Ontario, Canada. (*Steel ingots, plates and castings.*)

Steel Company of Canada, Hamilton, Ontario, Canada. (*Bars and angles, steel plates and billets.*)

TRIESTE.

"Ilva" Alti Forni e Acciaierie d'Italia: *Head Office*, Genoa.

Stabilimento di Ilvania. (*Steel ingots, billets and plates.*)

Stabilimento di Marghera. (*Steel castings, also Rolling Mills for small steel sections and bars.*)

TRIESTE—*continued.*

Società Anonima Fonderie Officine di Gorizia, Gorizia. (*Small steel castings.*)

VANCOUVER, B.C.

A.1. Iron & Steel Foundry Lim., Vancouver, B.C., Canada. (*Small steel castings.*)

Britannia Mining & Smelting Co., Lim., Britannia Beach, B.C., Canada. (*Small steel castings.*)

Dominion Bridge Co., Lim., Calgary Rolling Mill Dept., Calgary, Alberta, Canada. (*Sections and bars.*)

Manitoba Steel Foundries Lim., Selkirk, Manitoba, Canada. (*Steel castings.*)

Nanaimo Foundry & Engineering Works, Lim., Nanaimo, B.C., Canada. (*Small steel castings.*)

Reliance Foundry Co., Lim., Vancouver, B.C., Canada. (*Steel castings.*)

Riverside Iron Works, Lim., Calgary, Alberta, Canada. (*Steel castings.*)

Vancouver Engineering Works, Lim., Vancouver, B.C., Canada. (*Steel castings.*)

Victoria Machinery Depot Co., Lim., Victoria, B.C., Canada. (*Steel castings.*)

Vulcan Iron Works, Lim., Winnipeg, Manitoba, Canada. (*Steel castings.*)

Westland Steel Foundry Lim., Vancouver, B.C., Canada. (*Steel castings.*)

VIENNA.

Oesterreichisch-Alpine Montangesellschaft, Vienna.

Works at Donawitz, Styria. (*Plates and sections.*)

Works at Kindberg, Styria. (*Rolling Mills for small sections and bars.*)

WINTERTHUR.

Société Anonyme des Aciéries ci-devant Georges Fischer, Schaffhouse, Switzerland. (*Steel castings.*)

Société des Usines de Louis de Roll, Gerlafingen, Switzerland. (*Steel ingots, round bars and forgings.*)

Sulzer Frères, Société Anonyme, Winterthur, Switzerland. (*Steel castings.*)

LONDON.—*September, 1947.*

PROVING ESTABLISHMENTS.

The following Proving Establishments are recognised by the Committee of Lloyd's Register for the Testing of Anchors and Chains while licensed by the Board of Trade for that purpose:—

NETHERTON (near Dudley)—Lloyd's Proving House	Superintendent,	Mr. W. V. Norman.
LOW WALKER-ON-TYNE—Lloyd's Proving House	„	Mr. R. J. Vogan.
CHESTER (Saltney)—Lloyd's Proving House	„	Mr. S. Bolton.
GLASGOW—Lloyd's Proving House	„	Mr. L. L. Wright.
CARDIFF—Lloyd's Proving House	„	Mr. F. W. Dovey.
SUNDERLAND—Lloyd's Proving House	„	
CRADLEY HEATH—Lloyd's Proving House	„	Mr. H. Murphy.

The following Machines have been recognised by the Committee for the testing of Anchors and Chain Cables supplied to vessels of other than British Registry (*see* Section 39 of the Rules for Steel Vessels):—

All Proving Establishments in Germany and Japan which were on the approved list before the war have been omitted from the list which follows.

In countries which were occupied by forces from these nations, information regarding the proving establishments is still incomplete and their names have only been included if inspection has been carried out since the war.

AUSTRALIA	Falkiner Machinery Co., Proprietary, Lim., South Brisbane, Queensland (for testing Chains up to 100 tons).
BELGIUM	Adh. Demanet, Gosselies, Belgium (for testing chains up to 78 tons).
CANADA	Thos. Davidson Manufacturing Co., Lim., Turcot, Montreal.
„	Canada Chain & Forge Co., Lim., Granville Island, Vancouver, B.C.
„	Dominion Chain Co., Lim., Niagara Falls, Ontario.
„	McKinnon-Columbus Chain, Lim., St. Catherine's, Ontario.
FRANCE	Etablissement Sirot-Mestreit, St. Amand-les-Eaux (Nord).
„	Société Anonyme des Chaineries de St. Amand-les-Eaux, Etablissements Doré-mieux Fils & Cie., St. Amand-les-Eaux (Nord).
HOLLAND	Koninklijke Nederlandsche Grofsmederij, Leiden.
„	N.V. Anker-& Ketting-Industrie "Schiedam" (Managing Director—P. Th. Verhoeff), Schiedam.
ITALY	Acciaieria e Ferriera del Caleotto S.p.A., Lecco.
„	Società Pignone, *Works* at Leghorn. *Head Office* at Florence.
SPAIN	Forjas de San Martin de Pedro Framis, Barcelona (for testing Chains up to 16 tons).
„	Hijos di Vicinay, S. en C., Ochandiano, Vizcaya.
„	Cadenas y Forjádos, S.A.
SWEDEN	Gunnebo Bruks Nya Aktiebolag, Västervik (for testing Chains up to 20 tons).
„	Ljusne Woxna Aktiebolag, Ljusne.
„	Orsa Kattingfabrik, Orsa (for testing Chains up to 30 tons).
„	Ramnäs Bruks Aktiebolag, Ramnäs.
„	Statens Profningsanstalt (Government Establishment), Stockholm.
UNITED STATES	American Chain Co., Braddock, near Pittsburgh, Pa.; and York, Pa. (for testing Chains up to 22 tons).
„ „	Baldt Anchor, Chain and Forge Division of the Boston Metals Co., Chester, Pa.
„ „	Bellingham Chain & Forge Co., South Bellingham, Wash.
„ „	Buckeye Steel Castings Co., Columbus, Ohio (for breaking tests on Chain Cables only).
„ „	Carroll Chain Co., Columbus, Ohio.
„ „	Cleveland Chain & Manufacturing Co., Cleveland, Ohio.
„ „	Columbia Steel Co., Lim., Pittsburgh, Cal. (for the testing of Anchors only).
„ „	Continental Chain Corporation, Fieldsboro, N.J.

UNITED STATES... (*Cont.*)	General Steel Castings Corporation, Eddystone, Pa. (for the testing of Anchors only).
„ „ ...	Johnson-Farmer Chain Co., Lebanon, Pa.
„ „ ...	Jones & Laughlin Steel Co., Pittsburgh, Pa.
„ „ ...	Knoxville Iron Co., Knoxville, Tenn.
„ „ ...	National Erie Co., Erie, Pa. (for the testing of Anchors only).
„ „ ...	National Malleable and Steel Castings Co., Sharon, Pa.
„ „ ...	Penn Steel Castings Corporation, Chester, Pa. (for the testing of Anchors only).
UNITED STATES ... (*Cont.*)	Portland Chain Manufacturing Co., Portland, Or.
„ „ ...	Round California Chain Corporation, Lim., South San Francisco, California.
„ „ ...	Seattle Chain Co., 6921, East Marginal Way, Seattle, Wash.
„ „ ...	Taylor (S. G.) Chain Company, Hammond, Indiana.
„ „ ...	United States Chain & Forging Co., Pittsburgh, Pa.
„ „ ...	Woodhouse Chain Works, Trenton, N.J.

N.B.—Vessels supplied with Anchors and Chain Cables tested at any of the Establishments in the foregoing lists will have the notation of "Lloyd's A.&.C.P." in the Register Book, provided that in the case of machines outside Great Britain and Ireland the tests are carried out under the supervision of a Surveyor to the Society.

By order of the Committee,

P. E. CLEMENT,

Secretary.

LONDON.—*September, 1947.*

TABLES

OF

SCANTLINGS AND EQUIPMENT

FOR

STEEL VESSELS.

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The scantlings of sectional materials used in the Tables are British Standard Sections. Where it is proposed to use sectional materials complying with the revised British Standards described on pages 527-529 of the Rules, the Committee will be prepared to accept scantlings for such sections on the basis of equivalent strength.

KEELS, STEMS and STERNFRAMES. TABLE 1

FIRST LONGITUDINAL NUMERAL L × D		BAR KEELS.	STEMS.	STERNFRAMES WITHOUT APERTURES.	STERNFRAMES WITH APERTURES.	
Full Scantling Vessels.	Complete Superstructure Vessels.				Stern Post.	Rudder Post.
		Inches.	Inches.	Inches.	Inches.	Inches.
1000		6 × 1	5½ × 1	5½ × 1	5¼ × 2¼	5 × 2¼
1500		6½ × 1¼	5¾ × 1⅛	5¾ × 1¼	5½ × 2¾	5¼ × 2¾
2000		7 × 1½	6 × 1¼	6 × 1½	5¾ × 3¼	5½ × 3¼
2500	3000	7 × 1¾	6¼ × 1⅜	6¼ × 1¾	6 × 3¾	5¾ × 3¾
3000	3500	7¼ × 1⅞	6½ × 1½	6½ × 2	6¼ × 4¼	5¾ × 4¼
3500	4000	7½ × 2	6¾ × 1⅝	6¾ × 2⅛	6½ × 4½	5¾ × 4½
4000	4500	7½ × 2¼	7 × 1¾	7 × 2¼	6¾ × 5	6 × 5
4500	5000	7¾ × 2⅜	7¼ × 1⅞	7¼ × 2⅜	7 × 5¼	6¼ × 5¼
5000	6000	8¼ × 2⅜	7½ × 2	7½ × 2½	7½ × 5½	6¾ × 5½
6000	7000	8½ × 2½	7¾ × 2⅛	8 × 2⅝	8½ × 5½	7½ × 5½
7000	8500	9 × 2⅝	8 × 2¼	9 × 2⅝	9 × 5¾	8 × 5¾
8500	10000	10 × 2⅝	8½ × 2¼	9½ × 2¾	9½ × 6¼	8½ × 6¼
10000	12000	10½ × 2¾	9 × 2⅜	10 × 2⅞	10 × 7	9 × 7
12000	14000	11 × 2⅞	9½ × 2½	10½ × 3	10½ × 7½	9 × 7½
14000	16500		10 × 2⅝	10½ × 3¼	10½ × 8½	9 × 8½
16500	19000		10½ × 2¾	11 × 3⅜	11 × 9	9½ × 9
19000	22000		11 × 2⅞	11½ × 3½	11½ × 9½	10 × 9½
22000	26000		11 × 3⅛	11½ × 3¾	12 × 10	10½ × 10
26000	30000		11½ × 3¼	12 × 3⅞	12½ × 10½	11 × 10½
	34000		12 × 3¼	12 × 4	12½ × 11	11 × 11
	38000		12 × 3½	12 × 4¼	13 × 11½	11½ × 11½

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	21	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames	4 ×2½×·26	4 ×2½×·28	4 ×2½×·30	4 ×2½×·32	4 ×3 ×·32	
11	21½	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames	4 ×2½×·28	4 ×2½×·30	4 ×2½×·32	4 ×2½×·34	4 ×3 ×·34	4 ×3 ×·36
12	21½	Frames					2½×2½×·24	2½×2½×·26
		Reversed frames ..					2½×2½×·24	2½×2½×·26
		Depth of framing ..					2½	2½
		Angle frames	4 ×2½×·30		4 ×2½×·34	4½×3 ×·32	4½×3 ×·34	5 ×3 ×·30
13	22	Frames				3 ×2½×·24	3 ×2½×·26	3 ×2½×·28
		Reversed frames ..				2½×2½×·24	2½×2½×·26	2½×2½×·28
		Depth of framing ..				3	3	3
		Angle frames	4 ×2½×·34		4½×3 ×·32	5 ×3 ×·34	5 ×3 ×·38	5½×3 ×·34
14	22	Frames	2½×2½×·26			3 ×3 ×·28	3 ×3 ×·28	3 ×3 ×·30
		Reversed frames ..	2½×2½×·26			2½×2½×·28	3 ×2½×·28	3 ×2½×·30
		Depth of framing ..	2½			3	3½	3½
		Angle frames	4½×3 ×·38			5½×3 ×·34	5½×3 ×·40	6 ×3 ×·36
15	22½	Frames	3 ×2½×·26			3 ×3 ×·28	3 ×3 ×·30	3 ×3 ×·32
		Reversed frames ..	2½×2½×·26			3 ×2½×·28	3 ×2½×·30	3 ×2½×·32
		Depth of framing ..	3			3½	3½	3½
		Angle frames	5 ×3 ×·38			5½×3 ×·40	6 ×3 ×·36	6½×3 ×·34
16	22½	Frames	3½×2½×·26				3 ×3 ×·32	3 ×3 ×·34
		Reversed frames ..	2½×2½×·26				3 ×2½×·32	3 ×3 ×·34
		Depth of framing ..	3½				3½	3½
		Angle or bulb angle frames	5½×3 ×·36				6½×3 ×·34	5½×3 ×·32

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	21	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames						
11	21½	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames						
12	21½	Frames	3 ×2½×·26					
		Reversed frames ..	2½×2½×·26					
		Depth of framing ..	3					
		Angle frames	5 ×3 ×·38					
13	22	Frames	3 ×2½×·28	3 ×2½×·30				
		Reversed frames ..	3 ×2½×·28	3 ×2½×·30				
		Depth of framing ..	3½	3½				
		Angle frames	5½×3 ×·40	6 ×3 ×·36				
14	22	Frames	3 ×3 ×·32	3 ×3 ×·30	3 ×3 ×·32			
		Reversed frames ..	3 ×2½×·32	3 ×3 ×·30	3 ×3 ×·32			
		Depth of framing ..	3½	3½	3½			
		Angle or bulb angle frames	6½×3 ×·34	6½×3 ×·38	5½×3 ×·28			
15	22½	Frames	3 ×3 ×·32	3½×3 ×·30	3½×3 ×·32	3½×3 ×·32		
		Reversed frames ..	3 ×3 ×·32	3 ×3 ×·30	3 ×3 ×·32	3½×3 ×·32		
		Depth of framing ..	3½	4	4	4½		
		Bulb angle frames ..	5½×3 ×·28	5½×3 ×·34	5½×3 ×·40	6 ×3 ×·38		
16	22½	Frames	3½×3 ×·30	3½×3 ×·32	3½×3 ×·32	3½×3 ×·36	4 ×3 ×·36	
		Reversed frames ..	3 ×3 ×·30	3 ×3 ×·32	3½×3 ×·32	3½×3 ×·36	3½×3 ×·36	
		Depth of framing ..	4	4	4½	4½	5	
		Bulb angle frames ..	5½×3 ×·34	5½×3 ×·40	6 ×3 ×·38	6½×3 ×·32	6½×3 ×·44	

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.					
				Feet. 14	Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
17	23	Frames	$3\frac{1}{2}\times2\frac{1}{2}\times\cdot28$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot34$
		Reversed frames ..	$2\frac{1}{2}\times2\frac{1}{2}\times\cdot28$	$3\times3\times\cdot30$	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot34$
		Depth of framing..	$3\frac{1}{2}$	4	4	$4\frac{1}{2}$	$4\frac{1}{2}$	5	$5\frac{1}{2}$
		Angle or bulb angle frames	$5\frac{1}{2}\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot32$	$6\frac{1}{2}\times3\times\cdot38$	$7\times3\times\cdot36$
18	23	Frames	$3\frac{1}{2}\times2\frac{1}{2}\times\cdot28$		$4\times3\times\cdot32$	$4\times3\times\cdot34$	$4\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot36$
		Reversed frames ..	$3\times2\frac{1}{2}\times\cdot26$		$3\times3\times\cdot23$	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$
		Depth of framing..	4		$4\frac{1}{2}$	$4\frac{1}{2}$	5	$5\frac{1}{2}$	$5\frac{1}{2}$
		Angle or bulb angle frames	$6\times3\times\cdot38$		$6\times3\times\cdot38$	$6\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot46$	$7\times3\times\cdot40$
19	$23\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot28$			$4\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot40$
		Reversed frames ..	$3\times2\frac{1}{2}\times\cdot28$			$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot40$
		Depth of framing..	4			5	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$
		Angle or bulb angle frames	$6\frac{1}{2}\times3\times\cdot34$			$6\frac{1}{2}\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot46$	$7\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot36$
20	$23\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot30$				$4\frac{1}{2}\times3\times\cdot38$	$4\frac{1}{2}\times3\times\cdot40$	$4\frac{1}{2}\times3\times\cdot40$
		Reversed frames ..	$3\times2\frac{1}{2}\times\cdot30$				$4\times3\times\cdot38$	$4\times3\times\cdot40$	$4\frac{1}{2}\times3\times\cdot40$
		Depth of framing..	4				$5\frac{1}{2}$	$5\frac{1}{2}$	6
		Angle or bulb angle frames	$6\frac{1}{2}\times3\times\cdot36$				$7\times3\times\cdot44$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot44$
21	24	Frames	$3\frac{1}{2}\times3\times\cdot30$					$4\frac{1}{2}\times3\times\cdot42$	$5\times3\times\cdot40$
		Reversed frames ..	$3\times3\times\cdot30$					$4\frac{1}{2}\times3\times\cdot42$	$4\frac{1}{2}\times3\times\cdot40$
		Depth of framing..	4					6	$6\frac{1}{2}$
		Bulb angle frames	$5\frac{1}{2}\times3\times\cdot34$					$8\times3\times\cdot38$	$8\times3\times\cdot40$
22	24	Frames	$3\frac{1}{2}\times3\times\cdot32$						$5\times3\times\cdot40$
		Reversed frames ..	$3\times3\times\cdot32$						$5\times3\times\cdot40$
		Depth of framing..	4						7
		Bulb angle frames..	$5\frac{1}{2}\times3\times\cdot40$						$8\frac{1}{2}\times3\times\cdot40$
23	$24\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot34$						$5\times3\times\cdot44$
		Reversed frames ..	$3\times3\times\cdot34$						$5\times3\times\cdot44$
		Depth of framing..	4						7
		Bulb angle frames..	$6\times3\times\cdot30$						$8\frac{1}{2}\times3\times\cdot46$

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS TO DECK AT SIDE.						
			Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
17	23	Frames	$4\frac{1}{2}\times3\times\cdot38$						
		Reversed frames ..	$4\times3\times\cdot38$						
		Depth of framing..	$5\frac{1}{2}$						
		Bulb angle frames..	$7\times3\times\cdot44$						
18	23	Frames	$4\frac{1}{2}\times3\times\cdot38$	$5\times3\times\cdot38$					
		Reversed frames ..	$4\frac{1}{2}\times3\times\cdot38$	$4\frac{1}{2}\times3\times\cdot38$					
		Depth of framing..	6	$6\frac{1}{2}$					
		Bulb angle frames..	$7\frac{1}{2}\times3\times\cdot40$	$8\times3\times\cdot38$					
19	$23\frac{1}{2}$	Frames	$4\frac{1}{2}\times3\times\cdot40$	$5\times3\times\cdot40$	$5\times3\times\cdot40$				
		Reversed frames ..	$4\frac{1}{2}\times3\times\cdot40$	$4\frac{1}{2}\times3\times\cdot40$	$5\times3\times\cdot40$				
		Depth of framing..	6	$6\frac{1}{2}$	7				
		Bulb angle frames..	$7\frac{1}{2}\times3\times\cdot42$	$8\times3\times\cdot40$	$8\times3\times\cdot52$				
20	$23\frac{1}{2}$	Frames	$5\times3\times\cdot38$	$5\times3\times\cdot42$	$5\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot42$			
		Reversed frames ..	$4\frac{1}{2}\times3\times\cdot38$	$4\frac{1}{2}\times3\times\cdot42$	$5\times3\times\cdot42$	$5\times3\times\cdot42$			
		Depth of framing..	$6\frac{1}{2}$	$6\frac{1}{2}$	7	$7\frac{1}{2}$			
		Bulb angle frames..	$8\times3\times\cdot38$	$8\times3\times\cdot44$	$8\frac{1}{2}\times3\times\cdot42$	$8\frac{1}{2}\times3\times\cdot52$			
21	24	Frames	$5\times3\times\cdot42$	$5\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot42$	$6\times3\times\cdot44$		
		Reversed frames ..	$4\frac{1}{2}\times3\times\cdot42$	$5\times3\times\cdot42$	$5\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot44$		
		Depth of framing..	$6\frac{1}{2}$	7	$7\frac{1}{2}$	8	$8\frac{1}{2}$		
		Bulb angle frames..	$8\times3\times\cdot44$	$8\frac{1}{2}\times3\times\cdot42$	$8\frac{1}{2}\times3\times\cdot48$	$9\times3\times\cdot48$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$		
22	24	Frames	$5\times3\times\cdot44$	$5\frac{1}{2}\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot44$	$6\times3\times\cdot46$	$6\times3\times\cdot46$	
		Reversed frames ..	$5\times3\times\cdot44$	$5\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot44$	$5\frac{1}{2}\times3\times\cdot46$	$6\times3\times\cdot46$	
		Depth of framing..	7	$7\frac{1}{2}$	8	8	$8\frac{1}{2}$	9	
		Bulb angle frames..	$8\frac{1}{2}\times3\times\cdot46$	$8\frac{1}{2}\times3\times\cdot52$	$9\times3\times\cdot42$	$9\times3\times\cdot50$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$10\times3\frac{1}{2}\times\cdot48$	
23	$24\frac{1}{2}$	Frames	$5\frac{1}{2}\times3\times\cdot44$	$5\frac{1}{2}\times3\times\cdot44$	$6\times3\times\cdot44$				
		Reversed frames ..	$5\times3\times\cdot44$	$5\frac{1}{2}\times3\times\cdot44$	$5\frac{1}{2}\times3\times\cdot44$				
		Depth of framing..	$7\frac{1}{2}$	8	$8\frac{1}{2}$				
		Bulb angle frames..	$9\times3\times\cdot42$	$9\times3\times\cdot50$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$				

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.				
				Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
24	25	Frames..	4 ×3×·32	6 ×3×·42	6 ×3 ×·42	6 ×3 ×·44	6 ×3 ×·42	
		Reversed frames ..	3 ×3×·32	5 ×3×·42	5½×3 ×·42	5½×3½×·44	6 ×3½×·42	
		Depth of framing ..	4½	8	8½	8½	9	
		Bulb angle frames..	6 ×3×·38	9 ×3×·46	9½×3½×·44	10 ×3½×·46	10 ×3½×·50	
25	25½	Frames..	4 ×3×·34		6 ×3 ×·46	6 ×3 ×·46	6 ×3 ×·46	6½×3 ×·46
		Reversed frames ..	3 ×3×·34		5½×3 ×·46	5½×3½×·46	6 ×3½×·46	6 ×3½×·46
		Depth of framing ..	4½		8½	8½	9	9½
		Bulb angle frames..	6 ×3×·42		9½×3½×·50	10 ×3½×·50	10½×3½×·46	10½×3½×·54
26	26	Frames..	4 ×3×·36			6 ×3½×·46	6½×3½×·46	6½×3½×·46
		Reversed frames ..	3 ×3×·36			6 ×3½×·46	6 ×3½×·46	6½×3½×·46
		Depth of framing ..	4½			9	9½	10
		Bulb angle frames..	6½×3×·32			10½×3½×·46	10½×3½×·54	11 ×3½×·50
27	26½	Frames..	4½×3×·36				6½×3½×·46	6½×3½×·48
		Reversed frames ..	3 ×3×·38				6½×3½×·46	6½×3½×·48
		Depth of framing ..	4½				10	10
		Bulb angle frames..	6½×3×·36				11 ×3½×·50	11 ×3½×·56
28	27	Frames..	4½×3×·36					7 ×3½×·48
		Reversed frames ..	3 ×3×·36					6½×3½×·48
		Depth of framing ..	5					10½
		Bulb angle frames..	6½×3×·44					11½×3½×·50
29	27½	Frames..	5 ×3×·36					
		Reversed frames ..	3 ×3×·36					
		Depth of framing ..	5½					
		Bulb angle frames..	7 ×3×·40					
30	28	Frames..	5½×3×·38					
		Reversed frames ..	3 ×3×·38					
		Depth of framing ..	5½					
		Bulb angle frames..	7 ×3×·44					

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS—FLUSH DECK.

TABLE 2 (CONCLUDED.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.					
			Feet. 25	Feet. 26	Feet. 27	Feet. 28	Feet. 29	Feet. 30
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
24	25	Frames..						
		Reversed frames ..						
		Depth of framing ..						
		Bulb angle frames..						
25	$25\frac{1}{2}$	Frames..						
		Reversed frames ..						
		Depth of framing ..						
		Bulb angle frames..						
26	26	Frames..	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$					
		Reversed frames ..	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$					
		Depth of framing ..	10					
		Bulb angle frames..	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$					
27	$26\frac{1}{2}$	Frames..	$7 \times 3\frac{1}{2} \times \cdot 48$	$7 \times 3\frac{1}{2} \times \cdot 52$				
		Reversed frames ..	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$7 \times 3\frac{1}{2} \times \cdot 52$				
		Depth of framing ..	$10\frac{1}{2}$	$10\frac{1}{2}$				
		Bulb angle frames..	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$12 \times 3\frac{1}{2} \times \cdot 48$				
28	27	Frames..	$7 \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$			
		Reversed frames ..	$7 \times 3\frac{1}{2} \times \cdot 52$	$7 \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$			
		Depth of framing ..	$10\frac{1}{2}$	11	$11\frac{1}{2}$			
		Bulb angle frames..	$12 \times 3\frac{1}{2} \times \cdot 48$	$12 \times 3\frac{1}{2} \times \cdot 58$	$12 \times 3\frac{1}{2} \times \cdot 66$			
29	$27\frac{1}{2}$	Frames..	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 52$		
		Reversed frames ..	$7 \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 52$		
		Depth of framing ..	11	$11\frac{1}{2}$	12	$12\frac{1}{2}$		
		Bulb angle or channel frames	$12 \times 3\frac{1}{2} \times \cdot 56$	$12 \times 3\frac{1}{2} \times \cdot 66$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$12 \times 4 \times 4 \times \cdot 52$		
30	28	Frames..		$8 \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 54$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	
		Reversed frames ..		$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 52$	$8 \times 3\frac{1}{2} \times \cdot 54$	$8 \times 3\frac{1}{2} \times \cdot 54$	
		Depth of framing ..		12	$12\frac{1}{2}$	$12\frac{1}{2}$	13	
		Channel frames ..		$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$12 \times 4 \times 4 \times \cdot 52$	$12 \times 4 \times 4 \times \cdot 56$	$13 \times 4 \times 4 \times \cdot 50$	

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 2A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	21	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames	4 ×2½×·28	4 ×2½×·28	4 ×2½×·32	4 ×3 ×·36	4½×3 ×·34	
11	21½	Frames				2½×2½×·26	2½×2½×·28	3 ×2½×·26
		Reversed frames ..				2½×2½×·26	2½×2½×·28	2½×2½×·26
		Depth of framing ..				2½	2½	3
		Angle frames	4 ×2½×·30	4 ×2½×·30	4 ×3 ×·36	4½×3 ×·36	4½×3 ×·40	5 ×3 ×·38
12	21½	Frames				3 ×2½×·24	3 ×2½×·28	3 ×2½×·28
		Reversed frames ..				2½×2½×·24	2½×2½×·28	3 ×2½×·28
		Depth of framing ..				3	3	3½
		Angle frames	4 ×2½×·34		4½×3 ×·34	5 ×3 ×·36	5 ×3 ×·40	5½×3 ×·40
13	22	Frames			2½×2½×·28	3 ×2½×·28	3 ×2½×·28	3 ×3 ×·26
		Reversed frames ..			2½×2½×·28	2½×2½×·28	3 ×2½×·28	3 ×3 ×·26
		Depth of framing ..			2½	3	3½	3½
		Angle frames	4½×3 ×·34		4½×3 ×·40	5 ×3 ×·40	5½×3 ×·40	6 ×3 ×·38
14	22	Frames	3 ×2½×·26			3 ×2½×·28	3 ×3 ×·26	3 ×3 ×·30
		Reversed frames ..	2½×2½×·26			3 ×2½×·28	3 ×3 ×·26	3 ×3 ×·30
		Depth of framing ..	3			3½	3½	3½
		Angle frames	5 ×3 ×·38			5½×3 ×·40	6 ×3 ×·38	6½×3 ×·38
15	22½	Frames	3½×2½×·26			3 ×3 ×·26	3 ×3 ×·30	3 ×3 ×·34
		Reversed frames ..	2½×2½×·26			3 ×3 ×·26	3 ×3 ×·30	3 ×3 ×·34
		Depth of framing ..	3½			3½	3½	3½
		Angle or bulb angle frames	5½×3 ×·36			6 ×3 ×·38	6½×3 ×·38	5½×3 ×·32
16	22½	Frames	3½×2½×·26				3 ×3 ×·34	3½×3 ×·32
		Reversed frames ..	3 ×2½×·26				3 ×3 ×·34	3 ×3 ×·32
		Depth of framing ..	4				3½	4
		Angle or bulb angle frames	6 ×3 ×·36				5½×3 ×·32	5½×3 ×·40

SIDE FRAMING. TABLE 2A

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	21	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames						
11	21½	Frames						
		Reversed frames ..						
		Depth of framing ..						
		Angle frames						
12	21½	Frames	3 ×2½×·30					
		Reversed frames ..	3 ×2½×·30					
		Depth of framing ..	3½					
		Angle frames	5½×3 ×·42					
13	22	Frames	3 ×3 ×·30	3 ×3 ×·32				
		Reversed frames ..	3 ×3 ×·30	3 ×3 ×·32				
		Depth of framing ..	3½	3½				
		Angle or bulb angle frames	6½×3 ×·38	5½×3 ×·28				
14	22	Frames	3 ×3 ×·34	3½×3 ×·32	3½×3 ×·36			
		Reversed frames ..	3 ×3 ×·34	3 ×3 ×·32	3 ×3 ×·36			
		Depth of framing ..	3½	4	4			
		Bulb angle frames..	5½×3 ×·32	5½×3 ×·40	6 ×3 ×·34			
15	22½	Frames	3½×3 ×·32	3½×3 ×·32	3½×3 ×·36	4 ×3 ×·34		
		Reversed frames ..	3 ×3 ×·32	3½×3 ×·32	3½×3 ×·36	3½×3 ×·34		
		Depth of framing ..	4	4½	4½	5		
		Bulb angle frames..	5½×3 ×·40	6 ×3 ×·38	6½×3 ×·32	6½×3 ×·38		
16	22½	Frames	3½×3 ×·32	3½×3 ×·36	4 ×3 ×·34	4 ×3 ×·34	4½×3 ×·40	
		Reversed frames ..	3½×3 ×·32	3½×3 ×·36	3½×3 ×·34	4 ×3 ×·34	4 ×3 ×·40	
		Depth of framing ..	4½	4½	5	5½	5½	
		Bulb angle frames..	6 ×3 ×·38	6½×3 ×·32	6½×3 ×·38	7 ×3 ×·36	7½×3 ×·36	

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 2A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.					
				Feet. 14	Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
17	23	Frames	$3\frac{1}{2} \times 2\frac{1}{2} \times \cdot 28$	$3\frac{1}{2} \times 3 \times \cdot 32$	$3\frac{1}{2} \times 3 \times \cdot 36$	$4 \times 3 \times \cdot 34$	$4 \times 3 \times \cdot 34$	$4\frac{1}{2} \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 38$
		Reversed frames ..	$3 \times 2\frac{1}{2} \times \cdot 28$	$3\frac{1}{2} \times 3 \times \cdot 32$	$3\frac{1}{2} \times 3 \times \cdot 36$	$3\frac{1}{2} \times 3 \times \cdot 34$	$4 \times 3 \times \cdot 34$	$4 \times 3 \times \cdot 38$	$4 \times 3 \times \cdot 38$
		Depth of framing..	4	$4\frac{1}{2}$	$4\frac{1}{2}$	5	$5\frac{1}{2}$	$5\frac{1}{2}$	6
		Angle or bulb angle frames	$6\frac{1}{2} \times 3 \times \cdot 36$	$6 \times 3 \times \cdot 38$	$6\frac{1}{2} \times 3 \times \cdot 32$	$6\frac{1}{2} \times 3 \times \cdot 38$	$7 \times 3 \times \cdot 36$	$7 \times 3 \times \cdot 44$	$7\frac{1}{2} \times 3 \times \cdot 40$
18	23	Frames	$3\frac{1}{2} \times 3 \times \cdot 30$		$4 \times 3 \times \cdot 32$	$4 \times 3 \times \cdot 34$	$4\frac{1}{2} \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 42$
		Reversed frames ..	$3 \times 3 \times \cdot 30$		$4 \times 3 \times \cdot 32$	$4 \times 3 \times \cdot 34$	$4 \times 3 \times \cdot 38$	$4 \times 3 \times \cdot 38$	$4 \times 3 \times \cdot 42$
		Depth of framing..	4		$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	6	6
		Bulb angle frames..	$5\frac{1}{2} \times 3 \times \cdot 34$		$6\frac{1}{2} \times 3 \times \cdot 46$	$7 \times 3 \times \cdot 36$	$7 \times 3 \times \cdot 44$	$7\frac{1}{2} \times 3 \times \cdot 40$	$8 \times 3 \times \cdot 38$
19	$23\frac{1}{2}$	Frames	$3\frac{1}{2} \times 3 \times \cdot 32$			$4\frac{1}{2} \times 3 \times \cdot 36$	$5 \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 42$	$5 \times 3 \times \cdot 42$
		Reversed frames ..	$3 \times 3 \times \cdot 32$			$4 \times 3 \times \cdot 36$	$4 \times 3 \times \cdot 38$	$4 \times 3 \times \cdot 42$	$4\frac{1}{2} \times 3 \times \cdot 42$
		Depth of framing..	4			6	6	6	$6\frac{1}{2}$
		Bulb angle frames..	$5\frac{1}{2} \times 3 \times \cdot 40$			$7\frac{1}{2} \times 3 \times \cdot 36$	$7\frac{1}{2} \times 3 \times \cdot 40$	$8 \times 3 \times \cdot 38$	$8 \times 3 \times \cdot 44$
20	$23\frac{1}{2}$	Frames	$3\frac{1}{2} \times 3 \times \cdot 34$				$5 \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 42$	$5 \times 3 \times \cdot 42$
		Reversed frames ..	$3 \times 3 \times \cdot 34$				$4\frac{1}{2} \times 3 \times \cdot 38$	$4\frac{1}{2} \times 3 \times \cdot 38$	$5 \times 3 \times \cdot 42$
		Depth of framing..	4				$6\frac{1}{2}$	$6\frac{1}{2}$	7
		Bulb angle frames..	$6 \times 3 \times \cdot 30$				$8 \times 3 \times \cdot 38$	$8 \times 3 \times \cdot 44$	$8\frac{1}{2} \times 3 \times \cdot 42$
21	24	Frames	$4 \times 3 \times \cdot 32$					$5 \times 3 \times \cdot 44$	$5\frac{1}{2} \times 3 \times \cdot 42$
		Reversed frames ..	$3 \times 3 \times \cdot 32$					$5 \times 3 \times \cdot 44$	$5 \times 3 \times \cdot 42$
		Depth of framing..	$4\frac{1}{2}$					7	$7\frac{1}{2}$
		Bulb angle frames..	$6 \times 3 \times \cdot 38$					$8\frac{1}{2} \times 3 \times \cdot 46$	$8\frac{1}{2} \times 3 \times \cdot 52$
22	24	Frames	$4 \times 3 \times \cdot 34$						$5\frac{1}{2} \times 3 \times \cdot 44$
		Reversed frames ..	$3 \times 3 \times \cdot 34$						$5\frac{1}{2} \times 3 \times \cdot 44$
		Depth of framing..	$4\frac{1}{2}$						8
		Bulb angle frames..	$6 \times 3 \times \cdot 42$						$9 \times 3 \times \cdot 50$
23	$24\frac{1}{2}$	Frames	$4\frac{1}{2} \times 3 \times \cdot 34$						$6 \times 3 \times \cdot 42$
		Reversed frames ..	$3 \times 3 \times \cdot 34$						$5\frac{1}{2} \times 3 \times \cdot 42$
		Depth of framing..	5						$8\frac{1}{2}$
		Bulb angle frames..	$6\frac{1}{2} \times 3 \times \cdot 38$						$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 2A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.						
			Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
17	23	Frames	5 ×3 ×·38						
		Reversed frames ..	4½×3 ×·38						
		Depth of framing ..	6½						
		Bulb angle frames..	8 ×3 ×·38						
18	23	Frames	5 ×3 ×·42	5 ×3 ×·42					
		Reversed frames ..	4½×3 ×·42	5 ×3 ×·42					
		Depth of framing ..	6½	7					
		Bulb angle frames..	8 ×3 ×·44	8½×3 ×·42					
19	23½	Frames	5½×3 ×·40	5½×3 ×·40	5½×3 ×·44				
		Reversed frames ..	4½×3 ×·40	5 ×3 ×·40	5 ×3 ×·44				
		Depth of framing ..	7	7½	7½				
		Bulb angle frames..	8 ×3 ×·52	8½×3 ×·48	9 ×3 ×·42				
20	23½	Frames	5½×3 ×·40	5½×3 ×·44	5½×3 ×·44	6 ×3 ×·40			
		Reversed frames ..	5 ×3 ×·40	5 ×3 ×·44	5½×3 ×·44	5½×3½×·40			
		Depth of framing ..	7½	7½	8	8½			
		Bulb angle frames..	8½×3 ×·48	9 ×3 ×·42	9 ×3 ×·50	9½×3½×·48			
21	24	Frames	5½×3 ×·40	5½×3 ×·44	6 ×3 ×·40	6 ×3 ×·40	6½×3 ×·42		
		Reversed frames ..	5½×3 ×·40	5½×3 ×·44	5½×3½×·40	6 ×3½×·40	6 ×3½×·42		
		Depth of framing ..	8	8	8½	9	9½		
		Bulb angle frames..	9 ×3 ×·42	9 ×3 ×·50	9½×3½×·48	10 ×3½×·46	10½×3½×·46		
22	24	Frames	6 ×3 ×·38	6 ×3 ×·40	6 ×3 ×·40	6 ×3 ×·42	6½×3 ×·44	6½×3 ×·44	
		Reversed frames ..	5½×3½×·38	5½×3½×·40	6 ×3½×·40	6 ×3½×·42	6 ×3½×·44	6½×3½×·44	
		Depth of framing ..	8½	8½	9	9	9½	10	
		Bulb angle frames..	9½×3½×·44	9½×3½×·48	10×3½×·46	10 ×3½×·50	10½×3½×·48	10½×3½×·58	
23	24½	Frames	6 ×3 ×·42	6 ×3 ×·42	6½×3 ×·42				
		Reversed frames ..	5½×3½×·42	6 ×3½×·42	6 ×3½×·42				
		Depth of framing ..	8½	9	9½				
		Bulb angle frames..	9½×3½×·52	10×3½×·50	10½×3½×·46				

SIDE FRAMING.

TABLE 2A

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES. (SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO DECK AT SIDE.				
				Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
24	25	Frames..	4½ × 3 × ·36	6 × 3 × ·42	6½ × 3 × ·42	6½ × 3 × ·42	6½ × 3 × ·46	
		Reversed frames ..	3 × 3 × ·36	6 × 3½ × ·42	6 × 3½ × ·42	6½ × 3½ × ·42	6½ × 3½ × ·46	
		Depth of framing ..	5	9	9½	10	10	
		Bulb angle frames..	6½ × 3 × ·44	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·52	11 × 3½ × ·50	
25	25½	Frames..	5 × 3 × ·34		6½ × 3 × ·42	6½ × 3 × ·46	7 × 3 × ·46	7 × 3 × ·46
		Reversed frames ..	3 × 3 × ·34		6½ × 3½ × ·42	6½ × 3½ × ·46	6½ × 3½ × ·46	7 × 3½ × ·46
		Depth of framing ..	5½		10	10	10½	11
		Bulb angle frames..	7 × 3 × ·36		10½ × 3½ × ·52	11 × 3½ × ·50	11½ × 3½ × ·48	11½ × 3½ × ·54
26	26	Frames..	5 × 3 × ·36			7 × 3½ × ·44	7 × 3½ × ·44	7 × 3½ × ·48
		Reversed frames ..	3 × 3 × ·36			6½ × 3½ × ·44	7 × 3½ × ·44	7 × 3½ × ·48
		Depth of framing ..	5½			10½	11	11
		Bulb angle frames..	7 × 3 × ·40			11 × 3½ × ·54	11½ × 3½ × ·50	11½ × 3½ × ·60
27	26½	Frames..	5 × 3 × ·38				7 × 3½ × ·48	7½ × 3½ × ·48
		Reversed frames ..	3½ × 3 × ·38				7 × 3½ × ·48	7 × 3½ × ·48
		Depth of framing ..	5½				11	11½
		Bulb angle frames..	7 × 3 × ·44				11½ × 3½ × ·60	12 × 3½ × ·56
28	27	Frames..	5½ × 3½ × ·36					8 × 3½ × ·48
		Reversed frames ..	3 × 3 × ·36					7 × 3½ × ·48
		Depth of framing ..	6					12
		Bulb angle frames..	7½ × 3½ × ·36					12 × 3½ × ·66
29	27½	Frames..	5½ × 3½ × ·38					
		Reversed frames ..	3½ × 3 × ·38					
		Depth of framing ..	6					
		Bulb angle frames..	7½ × 3½ × ·40					
30	28	Frames..	5½ × 3½ × ·40					
		Reversed frames ..	3½ × 3 × ·40					
		Depth of framing ..	6					
		Bulb angle frames..	7½ × 3½ × ·44					

SIDE FRAMING.

FULL SCANTLING SINGLE DECK VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 2A (CONCLUDED.)

D	FRAME SPACING.	TYPE OF SPACING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS TO DECK AT SIDE.					
			Feet. 25	Feet. 26	Feet. 27	Feet. 28	Feet. 29	Feet. 30
Feet.	Inches.		Inches.	Inches	Inches.	Inches.	Inches.	Inches.
24	25	Frames..						
		Reversed frames ..						
		Depth of framing ..						
		Bulb angle frames..						
25	$25\frac{1}{2}$	Frames..						
		Reversed frames ..						
		Depth of framing ..						
		Bulb angle frames..						
26	26	Frames..	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$					
		Reversed frames ..	$7 \times 3\frac{1}{2} \times \cdot 48$					
		Depth of framing ..	$11\frac{1}{2}$					
		Bulb angle frames..	$12 \times 3\frac{1}{2} \times \cdot 56$					
27	$26\frac{1}{2}$	Frames..	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$				
		Reversed frames ..	$7 \times 3\frac{1}{2} \times \cdot 48$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$				
		Depth of framing ..	12	$12\frac{1}{2}$				
		Bulb angle or Channel frames	$12 \times 3\frac{1}{2} \times \cdot 66$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$				
28	27	Frames..	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$			
		Reversed frames ..	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$			
		Depth of framing ..	$12\frac{1}{2}$	13	$13\frac{1}{2}$			
		Channel frames ..	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$12 \times 4 \times 4 \times \cdot 50$	$12 \times 4 \times 4 \times \cdot 58$			
29	$27\frac{1}{2}$	Frames..	$8 \times 3\frac{1}{2} \times \cdot 48$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$9 \times 4 \times \cdot 48$	$9 \times 4 \times \cdot 52$		
		Reversed frames ..	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$		
		Depth of framing ..	13	$13\frac{1}{2}$	14	14		
		Channel frames ..	$12 \times 4 \times 4 \times \cdot 50$	$12 \times 4 \times 4 \times \cdot 58$	$13 \times 4 \times 4 \times \cdot 50$	$13 \times 4 \times 4 \times \cdot 58$		
30	28	Frames..		$9 \times 4 \times \cdot 48$	$9 \times 4 \times \cdot 52$	$9 \times 4 \times \cdot 54$	$9 \times 4 \times \cdot 58$	
		Reversed frames ..		$8 \times 3\frac{1}{2} \times \cdot 48$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$	
		Depth of framing ..		14	14	14	14	
		Channel frames ..		$13 \times 4 \times 4 \times \cdot 50$	$13 \times 4 \times 4 \times \cdot 58$	$13 \times 4 \times 4 \times \cdot 62$	$14 \times 4 \times 4 \times \cdot 56$	

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.						
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18	23	Frames	$3\frac{1}{2}\times2\frac{1}{2}\times\cdot26$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$					
		Reversed frames..	$3\times2\frac{1}{2}\times\cdot26$	$3\times2\frac{1}{2}\times\cdot30$	$3\times3\times\cdot30$					
		Depth of framing	4	4	4					
		Angle or bulb angle frames	$6\times3\times\cdot38$	$5\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot34$					
19	$23\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot28$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$				
		Reversed frames..	$3\times2\frac{1}{2}\times\cdot28$	$3\times3\times\cdot30$	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$				
		Depth of framing	4	4	4	$4\frac{1}{2}$				
		Angle or bulb angle frames	$6\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot38$				
20	$23\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot30$	$4\times3\times\cdot30$	$4\times3\times\cdot34$			
		Reversed frames..	$3\times2\frac{1}{2}\times\cdot30$	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot34$			
		Depth of framing	4	4	$4\frac{1}{2}$	5	5			
		Angle or bulb angle frames	$6\frac{1}{2}\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot32$	$6\times3\times\cdot44$	$6\frac{1}{2}\times3\times\cdot38$			
21	24	Frames	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$	$4\times3\times\cdot32$	$4\times3\times\cdot36$	$4\times3\times\cdot34$		
		Reversed frames..	$3\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$		
		Depth of framing	4	$4\frac{1}{2}$	$4\frac{1}{2}$	5	5	$5\frac{1}{2}$		
		Bulb angle frames	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot32$	$6\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot36$		
22	24	Frames	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot36$	$4\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot36$	
		Reversed frames..	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot36$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot32$	$4\times3\times\cdot36$	
		Depth of framing	4	$4\frac{1}{2}$	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6	6	
		Bulb angle frames	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot32$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot36$	$7\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot36$	
23	$24\frac{1}{2}$	Frames	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$
		Reversed frames..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\times3\times\cdot36$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$
		Depth of framing	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$
		Bulb angle frames	$6\times3\times\cdot30$	$6\frac{1}{2}\times3\times\cdot32$	$6\frac{1}{2}\times3\times\cdot38$	$7\times3\times\cdot36$	$7\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$
24	25	Frames	$4\times3\times\cdot32$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot36$
		Reversed frames..	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$
		Depth of framing	$4\frac{1}{2}$	5	5	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$	7
		Bulb angle frames	$6\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot40$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$	$8\times3\times\cdot42$
25	$25\frac{1}{2}$	Frames	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot40$	$5\times3\times\cdot38$
		Reversed frames..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot40$	$5\times3\times\cdot38$
		Depth of framing	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$	$6\frac{1}{2}$	7
		Bulb angle frames	$6\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot36$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$	$8\times3\times\cdot40$	$8\times3\times\cdot46$

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.								
			Feet. 17	Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18	23	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
19	$23\frac{1}{2}$	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
20	$23\frac{1}{2}$	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
21	24	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
22	24	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
23	$24\frac{1}{2}$	Frames									
		Reversed frames..									
		Depth of framing									
		Bulb angle frames									
24	25	Frames	5 × 3 × ·36								
		Reversed frames..	5 × 3 × ·36								
		Depth of framing	$7\frac{1}{2}$								
		Bulb angle frames	$8\frac{1}{2} \times 3 \times \cdot 38$								
25	$25\frac{1}{2}$	Frames	$5\frac{1}{2} \times 3 \times \cdot 38$	$5\frac{1}{2} \times 3 \times \cdot 42$							
		Reversed frames..	5 × 3 × ·38	5 × 3 × ·42							
		Depth of framing	$7\frac{1}{2}$	$7\frac{1}{2}$							
		Bulb angle frames	$8\frac{1}{2} \times 3 \times \cdot 44$	$8\frac{1}{2} \times 3 \times \cdot 52$							

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.							
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16	Feet. 17
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames	4 × 3 × ·36	4½ × 3½ × ·34	4½ × 3½ × ·36	4½ × 3½ × ·36	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·40
		Reversed frames..	3 × 3 × ·36	3 × 3½ × ·34	3 × 3½ × ·36	3½ × 3½ × ·36	4 × 3½ × ·38	4 × 3½ × ·38	4 × 3½ × ·40	4½ × 3½ × ·40	5 × 3½ × ·40
		Depth of framing	4½	5	5	5½	5½	6	6	6½	7
		Bulb angle frames	6½ × 3 × ·32	7 × 3½ × ·36	7 × 3½ × ·40	7½ × 3½ × ·36	7½ × 3½ × ·40	8 × 3½ × ·38	8 × 3½ × ·42	8 × 3½ × ·50	8½ × 3½ × ·48
27	26½	Frames	4½ × 3 × ·34	4½ × 3½ × ·36	4½ × 3½ × ·36	4½ × 3½ × ·38	4½ × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44
		Reversed frames..	3 × 3 × ·34	3 × 3½ × ·36	3½ × 3½ × ·36	4 × 3½ × ·38	4 × 3½ × ·42	4 × 3½ × ·40	4½ × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44
		Depth of framing	5	5	5½	5½	5½	6	6½	7	7
		Bulb angle frames	6½ × 3 × ·38	7 × 3½ × ·40	7½ × 3½ × ·36	7½ × 3½ × ·40	7½ × 3½ × ·48	8 × 3½ × ·42	8 × 3½ × ·50	8½ × 3½ × ·48	9 × 3½ × ·42
28	27	Frames	4½ × 3 × ·36	5 × 3½ × ·36	5 × 3½ × ·38	5 × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·42	5 × 3½ × ·42	5 × 3½ × ·42	5½ × 3½ × ·42
		Reversed frames..	3 × 3 × ·36	3 × 3½ × ·36	3½ × 3½ × ·38	3½ × 3½ × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·42	5 × 3½ × ·42	5 × 3½ × ·42
		Depth of framing	5	5½	5½	5½	6	6	6½	7	7½
		Bulb angle frames	6½ × 3 × ·44	7½ × 3½ × ·36	7½ × 3½ × ·40	7½ × 3½ × ·48	8 × 3½ × ·42	8 × 3½ × ·46	8½ × 3½ × ·42	8½ × 3½ × ·52	9 × 3½ × ·48
29	27½	Frames	5 × 3 × ·36	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44	5½ × 3½ × ·44
		Reversed frames..	3 × 3 × ·36	3½ × 3½ × ·38	3½ × 3½ × ·40	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44	5 × 3½ × ·44
		Depth of framing	5½	5½	5½	6	6	6½	7	7	7½
		Bulb angle frames	7 × 3 × ·40	7½ × 3½ × ·40	7½ × 3½ × ·44	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·50	8½ × 3½ × ·48	9 × 3½ × ·42	9 × 3½ × ·52
30	28	Frames	5½ × 3 × ·38	5 × 3½ × ·42	5 × 3½ × ·38	5 × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·38	5 × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·46
		Reversed frames..	3 × 3 × ·38	3½ × 3½ × ·42	4 × 3½ × ·38	4 × 3½ × ·42	4½ × 3½ × ·40	5 × 3½ × ·38	5 × 3½ × ·42	5 × 3½ × ·42	5 × 3½ × ·46
		Depth of framing	5½	5½	6	6	6½	7	7	7½	7½
		Bulb angle frames	7 × 3 × ·44	7½ × 3½ × ·48	7½ × 3½ × ·50	8 × 3½ × ·46	8 × 3½ × 50	8½ × 3½ × ·42	8½ × 3½ × ·52	9 × 3½ × ·48	9½ × 3½ × ·44
31	28½	Frames	5½ × 3 × ·40	5½ × 3½ × ·40	5½ × 3½ × ·42	5½ × 3½ × ·40	5½ × 3½ × ·42	5½ × 3½ × ·40	5½ × 3½ × ·40	5½ × 3½ × ·44	6 × 3½ × ·44
		Reversed frames..	3 × 3 × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44	5 × 3½ × ·44
		Depth of framing	5½	6	6	6½	6½	7	7½	7½	8
		Bulb angle frames	7½ × 3 × ·36	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·50	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·44	9 × 3½ × ·52	9½ × 3½ × ·48
32	29	Frames	5½ × 3 × ·42	5½ × 3½ × ·42	5½ × 3½ × ·44	5½ × 3½ × ·42	5½ × 3½ × ·40	5½ × 3½ × ·44	5½ × 3½ × ·42	5½ × 3½ × ·46	6 × 3½ × ·46
		Reversed frames..	3 × 3 × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·44	5 × 3½ × ·42	5 × 3½ × ·46	5 × 3½ × ·46
		Depth of framing	5½	6	6	6½	7	7	7½	7½	8
		Bulb angle frames	7½ × 3 × ·38	8 × 3½ × ·46	8 × 3½ × ·50	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·42	9 × 3½ × ·48	9½ × 3½ × ·44	9½ × 3½ × ·52

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.							
			Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$						
		Reversed frames..	$5\times3\frac{1}{2}\times\cdot40$	$5\times3\frac{1}{2}\times\cdot44$						
		Depth of framing	$7\frac{1}{2}$	$7\frac{1}{2}$						
		Bulb angle frames	$9\times3\frac{1}{2}\times\cdot44$	$9\times3\frac{1}{2}\times\cdot52$						
27	$26\frac{1}{2}$	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot44$					
		Reversed frames..	$5\times3\frac{1}{2}\times\cdot44$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$					
		Depth of framing	$7\frac{1}{2}$	8	$8\frac{1}{2}$					
		Bulb angle frames	$9\times3\frac{1}{2}\times\cdot52$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$10\times3\frac{1}{2}\times\cdot46$					
28	27	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$				
		Reversed frames..	$5\times3\frac{1}{2}\times\cdot46$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$				
		Depth of framing	$7\frac{1}{2}$	8	$8\frac{1}{2}$	9				
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$10\times3\frac{1}{2}\times\cdot50$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$				
29	$27\frac{1}{2}$	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot46$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$			
		Reversed frames..	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$			
		Depth of framing	8	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10			
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$10\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$11\times3\frac{1}{2}\times\cdot50$			
30	28	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot48$		
		Reversed frames..	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot48$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$		
		Depth of framing	8	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10	$10\frac{1}{2}$		
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$10\times3\frac{1}{2}\times\cdot54$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$11\times3\frac{1}{2}\times\cdot56$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot50$		
31	$28\frac{1}{2}$	Frames	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot46$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$7\times3\frac{1}{2}\times\cdot46$	$7\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot48$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	
		Reversed frames..	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$	$6\times3\frac{1}{2}\times\cdot46$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot48$	
		Depth of framing	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	
		Bulb angle frames	$10\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$11\times3\frac{1}{2}\times\cdot50$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot60$	$12\times3\frac{1}{2}\times\cdot56$	
32	29	Frames	$6\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot48$	$7\times3\frac{1}{2}\times\cdot50$	$7\times3\frac{1}{2}\times\cdot50$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$8\times3\frac{1}{2}\times\cdot52$
		Reversed frames..	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot44$	$6\times3\frac{1}{2}\times\cdot48$	$6\times3\frac{1}{2}\times\cdot48$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$7\times3\frac{1}{2}\times\cdot50$	$7\times3\frac{1}{2}\times\cdot50$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot52$
		Depth of framing	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	12
		Bulb angle or channel frames	$10\times3\frac{1}{2}\times\cdot54$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$11\times3\frac{1}{2}\times\cdot56$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot56$	$12\times3\frac{1}{2}\times\cdot52$	$12\times3\frac{1}{2}\times\cdot62$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot56$

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	6 × 3 × ·40	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·42
		Reversed frames ..	3 × 3 × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·42
		Depth of framing ..	6	6½	6½	7	7	7½
		Bulb angle frames..	7½ × 3 × ·44	8 × 3½ × ·50	8½ × 3½ × ·42	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·48
34	30	Frames	6 × 3 × ·40	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·40	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·42	5 × 3½ × ·40
		Depth of framing ..	6½	7	7	7½	7½	8
		Bulb angle frames..	8 × 3 × ·40	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·42
35	30½	Frames	6½ × 3 × ·40	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42
		Reversed frames ..	3½ × 3 × ·40	3½ × 3½ × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·42
		Depth of framing ..	7	7	7½	7½	8	8
		Bulb angle frames..	8½ × 3 × ·40	8½ × 3½ × ·52	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·42	9½ × 3½ × ·46
36	31	Frames	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·44	6½ × 3½ × ·46
		Reversed frames ..	3½ × 3½ × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·44	4½ × 3½ × ·46
		Depth of framing ..	7	7½	7½	8	8	8
		Bulb angle frames..	9 × 3½ × ·40	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·42	9½ × 3½ × ·48	9½ × 3½ × ·52
37	31½	Frames	7 × 3½ × ·40	7 × 3½ × ·40	7 × 3½ × ·42	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·44
		Reversed frames ..	3½ × 3½ × ·40	4 × 3½ × ·40	4 × 3½ × ·42	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·44
		Depth of framing ..	7½	8	8	8	8	8½
		Bulb angle frames..	9 × 3½ × ·44	9½ × 3½ × ·42	9½ × 3½ × ·46	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·46
38	32	Frames	7 × 3½ × ·42	7 × 3½ × ·42	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·46	7 × 3½ × ·44
		Reversed frames ..	3½ × 3½ × ·42	4 × 3½ × ·42	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·46	5 × 3½ × ·44
		Depth of framing ..	7½	8	8	8	8½	9
		Bulb angle frames..	9 × 3½ × ·48	9½ × 3½ × ·46	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·50	10 × 3½ × ·54
39	32½	Frames	7½ × 3½ × ·42	7½ × 3½ × ·44	7½ × 3½ × ·46	7½ × 3½ × ·46	7½ × 3½ × ·44	7½ × 3½ × ·46
		Reversed frames ..	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·46	4 × 3½ × ·46	4½ × 3½ × ·44	4½ × 3½ × ·46
		Depth of framing ..	8	8	8	8½	9	9
		Bulb angle frames..	9½ × 3½ × ·46	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·48

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	6 × 3½ × ·42	6 × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·46
		Reversed frames ..	5 × 3½ × ·42	5 × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·46
		Depth of framing..	8	8	8½	9	9½	10
		Bulb angle frames..	9½ × 3½ × ·46	9½ × 3½ × ·52	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·54	11 × 3½ × ·50
34	30	Frames	6 × 3½ × ·44	6 × 3½ × ·48	6 × 3½ × ·48	6 × 3½ × ·48	6½ × 3½ × ·48	6½ × 3½ × ·50
		Reversed frames ..	5 × 3½ × ·44	5 × 3½ × ·48	5½ × 3½ × ·48	6 × 3½ × ·48	6 × 3½ × ·48	6½ × 3½ × ·50
		Depth of framing..	8	8	8½	9	9½	10
		Bulb angle frames..	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·58	11½ × 3½ × ·48
35	30½	Frames	6½ × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·48
		Reversed frames ..	4½ × 3½ × ·46	5 × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·48	6½ × 3½ × ·48	6½ × 3½ × ·48
		Depth of framing..	8	8½	9	9½	10	10½
		Bulb angle frames..	9½ × 3½ × ·52	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·58	11 × 3½ × ·56	11½ × 3½ × ·50
36	31	Frames	6½ × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·50	6½ × 3½ × ·50	6½ × 3½ × ·50	7 × 3½ × ·50
		Reversed frames ..	5 × 3½ × ·46	5 × 3½ × ·48	5½ × 3½ × ·50	6 × 3½ × ·50	6½ × 3½ × ·50	6½ × 3½ × ·50
		Depth of framing..	8½	8½	9	9½	10	10½
		Bulb angle frames..	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·48	11½ × 3½ × ·56
37	31½	Frames	7 × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·50	7 × 3½ × ·50
		Reversed frames ..	4½ × 3½ × ·48	5 × 3½ × ·48	5½ × 3½ × ·48	6 × 3½ × ·48	6½ × 3½ × ·50	7 × 3½ × ·50
		Depth of framing..	8½	9	9½	10	10½	11
		Bulb angle frames..	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·58	11 × 3½ × ·56	11½ × 3½ × ·56	12 × 3½ × ·52
38	32	Frames	7 × 3½ × ·48	7½ × 3½ × ·46	7½ × 3½ × ·50	7½ × 3½ × ·50	7½ × 3½ × ·52	7½ × 3½ × ·52
		Reversed frames ..	5 × 3½ × ·48	5 × 3½ × ·46	5 × 3½ × ·50	5½ × 3½ × ·50	6½ × 3½ × ·52	7 × 3½ × ·52
		Depth of framing..	9	9½	9½	10	10½	11
		Bulb angle frames..	10½ × 3½ × ·50	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·48	11½ × 3½ × ·60	12 × 3½ × ·56
39	32½	Frames	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·50
		Reversed frames ..	4½ × 3½ × ·46	4½ × 3½ × ·48	5 × 3½ × ·48	5½ × 3½ × ·48	6 × 3½ × ·50	6½ × 3½ × ·50
		Depth of framing..	9½	9½	10	10½	11	11½
		Bulb angle frames..	10½ × 3½ × ·54	10½ × 3½ × ·58	11 × 3½ × ·56	11½ × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·62

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	7 × 3½ × ·48	7½ × 3½ × ·48	7½ × 3½ × ·50	7½ × 3½ × ·50		
		Reversed frames ..	6½ × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·50	7½ × 3½ × ·50		
		Depth of framing ..	10½	11	11½	12		
		Bulb angle or channel frames	11½ × 3½ × ·50	11½ × 3½ × ·60	12 × 3½ × ·62	12 × 3½ × 3½ × ·52		
34	30	Frames	7 × 3½ × ·50	7½ × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·54	
		Reversed frames ..	6½ × 3½ × ·50	6½ × 3½ × ·50	7½ × 3½ × ·52	7½ × 3½ × ·52	8 × 3½ × ·54	
		Depth of framing ..	10½	11	11½	12	12½	
		Bulb angle or channel frames	11½ × 3½ × ·56	12 × 3½ × ·52	12 × 3½ × ·66	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·56	
35	30½	Frames	7 × 3½ × ·50	7½ × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·52
		Reversed frames ..	7 × 3½ × ·50	7 × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·52
		Depth of framing ..	11	11½	12	12½	13	13½
		Bulb angle or channel frames	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·52	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52
36	31	Frames	7½ × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·54	8½ × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·56
		Reversed frames ..	7 × 3½ × ·52	7½ × 3½ × ·52	7½ × 3½ × ·54	8 × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·56
		Depth of framing ..	11	11½	12	13	13½	13½
		Bulb angle or channel frames	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58
37	31½	Frames	7½ × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·56	9 × 4 × ·56
		Reversed frames ..	7 × 3½ × ·50	7 × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·54	8½ × 3½ × ·56	8½ × 3½ × ·56
		Depth of framing ..	11½	12	12½	13	13½	14
		Bulb angle or channel frames	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52
38	32	Frames	7½ × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·52	8½ × 3½ × ·54	9 × 4 × ·54	9 × 4 × ·58
		Reversed frames ..	7½ × 3½ × ·50	7½ × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·54	8½ × 3½ × ·58
		Depth of framing ..	12	12½	13	13½	14	14
		Channel frames ..	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·58	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62	14 × 4 × 4 × ·56
39	32½	Frames	8 × 3½ × ·52	8 × 3½ × ·50	8½ × 3½ × ·54	8½ × 3½ × ·56	9 × 4 × ·56	9½ × 4 × ·54
		Reversed frames ..	7½ × 3½ × ·52	8 × 3½ × ·50	8 × 3½ × ·54	8½ × 3½ × ·56	8½ × 3½ × ·56	8½ × 4 × ·54
		Depth of framing ..	12	13	13	13½	14	14½
		Channel frames ..	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·54	13 × 4 × 4 × ·50	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52	15 × 4 × 4 × ·52

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 44$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 44$
		Reversed frames ..	$3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$4 \times 3\frac{1}{2} \times \cdot 44$	$4 \times 3\frac{1}{2} \times \cdot 46$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$
		Depth of framing ..	8	8	$8\frac{1}{2}$	9	9	$9\frac{1}{2}$
		Bulb angle frames..	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$10 \times 3\frac{1}{2} \times \cdot 50$	$10 \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$
41	$33\frac{1}{2}$	Frames	$8 \times 3\frac{1}{2} \times \cdot 44$	$8 \times 3\frac{1}{2} \times \cdot 44$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 44$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 44$
		Reversed frames ..	$3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$4 \times 3\frac{1}{2} \times \cdot 44$	$4 \times 3\frac{1}{2} \times \cdot 46$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$5 \times 3\frac{1}{2} \times \cdot 44$
		Depth of framing ..	$8\frac{1}{2}$	9	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10
		Bulb angle frames..	$10 \times 3\frac{1}{2} \times \cdot 46$	$10 \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$
42	34	Frames	$8 \times 3\frac{1}{2} \times \cdot 44$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$
		Reversed frames ..	$4 \times 3\frac{1}{2} \times \cdot 44$	$4 \times 3\frac{1}{2} \times \cdot 46$	$4 \times 3\frac{1}{2} \times \cdot 48$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$5 \times 3\frac{1}{2} \times \cdot 46$
		Depth of framing ..	9	9	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10
		Bulb angle frames..	$10 \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$	$11 \times 3\frac{1}{2} \times \cdot 50$
43	$34\frac{1}{2}$	Frames	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$
		Reversed frames ..	$4 \times 3\frac{1}{2} \times \cdot 46$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$5 \times 3\frac{1}{2} \times \cdot 46$	$5 \times 3\frac{1}{2} \times \cdot 48$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$
		Depth of framing ..	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10	10	$10\frac{1}{2}$
		Bulb angle frames..	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$	$11 \times 3\frac{1}{2} \times \cdot 50$	$11 \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$
44	35	Frames	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 46$
		Reversed frames ..	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$5 \times 3\frac{1}{2} \times \cdot 46$	$5 \times 3\frac{1}{2} \times \cdot 48$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$6 \times 3\frac{1}{2} \times \cdot 46$
		Depth of framing ..	$9\frac{1}{2}$	10	10	$10\frac{1}{2}$	$10\frac{1}{2}$	11
		Bulb angle frames..	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$11 \times 3\frac{1}{2} \times \cdot 50$	$11 \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$
45	$35\frac{1}{2}$	Frames	$8 \times 3\frac{1}{2} \times \cdot 46$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 50$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 50$	$8 \times 3\frac{1}{2} \times \cdot 48$
		Reversed frames ..	$5 \times 3\frac{1}{2} \times \cdot 46$	$5 \times 3\frac{1}{2} \times \cdot 48$	$5 \times 3\frac{1}{2} \times \cdot 50$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$6 \times 3\frac{1}{2} \times \cdot 48$
		Depth of framing ..	10	10	10	$10\frac{1}{2}$	$10\frac{1}{2}$	11
		Bulb angle frames..	$11 \times 3\frac{1}{2} \times \cdot 50$	$11 \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 60$
46	36	Frames	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 50$	$8 \times 3\frac{1}{2} \times \cdot 48$	$8 \times 3\frac{1}{2} \times \cdot 50$	$8 \times 3\frac{1}{2} \times \cdot 48$
		Reversed frames ..	$5 \times 3\frac{1}{2} \times \cdot 48$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$6 \times 3\frac{1}{2} \times \cdot 48$	$6 \times 3\frac{1}{2} \times \cdot 50$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$
		Depth of framing ..	10	$10\frac{1}{2}$	$10\frac{1}{2}$	11	11	$11\frac{1}{2}$
		Bulb angle frames..	$11 \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 60$	$12 \times 3\frac{1}{2} \times \cdot 52$	$12 \times 3\frac{1}{2} \times \cdot 56$

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·50
		Reversed frames ..	4½ × 3½ × ·48	5 × 3½ × ·48	5½ × 3½ × ·48	6 × 3½ × ·48	6½ × 3½ × ·50	7 × 3½ × ·50
		Depth of framing ..	9½	10	10½	11	11½	12
		Bulb angle or channel frames	10½ × 3½ × ·58	11 × 3½ × ·56	11½ × 3½ × ·50	11½ × 3½ × ·60	12 × 3½ × ·62	12 × 3½ × 3½ × ·52
41	33½	Frames	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·52	8 × 3½ × ·50
		Reversed frames ..	5 × 3½ × ·48	5 × 3½ × ·50	6 × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·52	7½ × 3½ × ·50
		Depth of framing ..	10	10	11	11½	11½	12½
		Bulb angle or channel frames	11 × 3½ × ·56	11½ × 3½ × ·48	11½ × 3½ × ·60	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·58
42	34	Frames	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52
		Reversed frames ..	5 × 3½ × ·50	5½ × 3½ × ·50	6 × 3½ × ·50	6½ × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52
		Depth of framing ..	10	10½	11	11½	12	12½
		Bulb angle or channel frames	11½ × 3½ × ·48	11½ × 3½ × ·56	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·52
43	34½	Frames	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·52
		Reversed frames ..	5½ × 3½ × ·50	6 × 3½ × ·50	6½ × 3½ × ·50	7 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52
		Depth of framing ..	10½	11	11½	12	12½	13
		Bulb angle or channel frames	11½ × 3½ × ·56	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	12 × 4 × 4 × ·58
44	35	Frames	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·54	8½ × 3½ × ·54
		Reversed frames ..	6 × 3½ × ·50	6½ × 3½ × ·50	7 × 3½ × ·52	7½ × 3½ × ·52	8 × 3½ × ·54	8 × 3½ × ·54
		Depth of framing ..	11	11½	11½	12	12½	13
		Bulb angle or channel frames	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × ·66	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·56	13 × 4 × 4 × ·50
45	35½	Frames	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·54
		Reversed frames ..	6½ × 3½ × ·50	7 × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·54
		Depth of framing ..	11½	12	12	12½	13	13½
		Bulb angle or channel frames	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54
46	36	Frames	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·58
		Reversed frames ..	7 × 3½ × ·50	7½ × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·58
		Depth of framing ..	12	12½	12½	13	13½	13½
		Channel frames ..	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·52	12 × 4 × 4 × ·58	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62

SIDE FRAMING.

FULL SCANTLING VESSELS—FLUSH DECK.

TABLE 3 (CONCLUDED.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	8 × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·54	9 × 4 × ·54	9½ × 4 × ·52	9½ × 4 × ·56
		Reversed frames ..	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·54	8½ × 4 × ·52	8½ × 4 × ·56
		Depth of framing ..	12½	13	13½	14	14½	14½
		Channel frames ..	12 × 4 × 4 × ·52	12 × 4 × 4 × ·58	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62	14 × 4 × 4 × ·58	15 × 4 × 4 × ·54
41	33½	Frames	8½ × 3½ × ·54	8½ × 3½ × ·52	8½ × 3½ × ·56	9 × 4 × ·58	9½ × 4 × ·54	9½ × 4 × ·60
		Reversed frames ..	7½ × 3½ × ·54	8½ × 3½ × ·52	8½ × 3½ × ·56	8½ × 3½ × ·58	8½ × 4 × ·54	8½ × 4 × ·60
		Depth of framing ..	12½	13½	13½	14	14½	14½
		Channel frames ..	12 × 4 × 4 × ·56	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58	14 × 4 × 4 × ·56	15 × 4 × 4 × ·52	15 × 4 × 4 × ·58
42	34	Frames	8½ × 3½ × ·54	8½ × 3½ × ·54	9 × 4 × ·56	9 × 4 × ·60	9½ × 4 × ·58	9½ × 4 × ·62
		Reversed frames ..	8 × 3½ × ·54	8½ × 3½ × ·54	8½ × 3½ × ·56	8½ × 3½ × ·60	8½ × 4 × ·58	8½ × 4 × ·62
		Depth of framing ..	13	13½	14	14	14½	14½
		Channel frames ..	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54	14 × 4 × 4 × ·52	14 × 4 × 4 × ·58	15 × 4 × 4 × ·56	15 × 4 × 4 × ·62
43	34½	Frames	8½ × 3½ × ·54	9 × 4 × ·54	9½ × 4 × ·52	9½ × 4 × ·56	9½ × 4 × ·60	9½ × 4 × ·66
		Reversed frames ..	8½ × 3½ × ·54	8½ × 3½ × ·54	8½ × 4 × ·52	8½ × 4 × ·56	8½ × 4 × ·60	8½ × 4 × ·66
		Depth of framing ..	13½	14	14½	14½	14½	14½
		Channel frames ..	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62	14 × 4 × 4 × ·58	15 × 4 × 4 × ·54	15 × 4 × 4 × ·58	15 × 4 × 4 × ·66
44	35	Frames	8½ × 3½ × ·56	9 × 4 × ·56	9½ × 4 × ·54	9½ × 4 × ·58	9½ × 4 × ·64	
		Reversed frames ..	8½ × 3½ × ·56	8½ × 3½ × ·56	8½ × 4 × ·54	8½ × 4 × ·58	8½ × 4 × ·64	
		Depth of framing ..	13½	14	14½	14½	14½	
		Channel frames ..	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52	15 × 4 × 4 × ·52	15 × 4 × 4 × ·56	15 × 4 × 4 × ·64	
45	35½	Frames	9 × 4 × ·56	9½ × 4 × ·52	9½ × 4 × ·56	9½ × 4 × ·62		
		Reversed frames ..	8½ × 3½ × ·56	8½ × 4 × ·52	8½ × 4 × ·56	8½ × 4 × ·62		
		Depth of framing ..	14	14½	14½	14½		
		Channel frames ..	14 × 4 × 4 × ·52	14 × 4 × 4 × ·58	15 × 4 × 4 × ·54	15 × 4 × 4 × ·62		
46	36	Frames	9 × 4 × ·58	9½ × 4 × ·54	9½ × 4 × ·60			
		Reversed frames ..	8½ × 3½ × ·58	8½ × 4 × ·54	8½ × 4 × ·60			
		Depth of framing ..	14	14½	14½			
		Channel frames ..	14 × 4 × 4 × ·56	15 × 4 × 4 × ·52	15 × 4 × 4 × ·58			

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.						
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18	23	Frames..	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$					
		Reversed frames ..	$3\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot32$					
		Depth of framing ..	4	$4\frac{1}{2}$	$4\frac{1}{2}$					
		Bulb angle frames..	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot32$	$6\times3\times\cdot38$					
19	$23\frac{1}{2}$	Frames..	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot32$	$4\times3\times\cdot30$				
		Reversed frames ..	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot32$	$4\times3\times\cdot30$				
		Depth of framing ..	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$				
		Bulb angle frames..	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot40$				
20	$23\frac{1}{2}$	Frames..	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot32$	$4\times3\times\cdot34$	$4\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot32$			
		Reversed frames ..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot32$	$4\times3\times\cdot32$			
		Depth of framing ..	4	5	5	$5\frac{1}{2}$	6			
		Bulb angle frames..	$6\times3\times\cdot30$	$6\frac{1}{2}\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot46$	$7\times3\times\cdot40$			
21	24	Frames..	$4\times3\times\cdot32$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot36$		
		Reversed frames ..	$3\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot34$	$4\times3\times\cdot36$		
		Depth of framing ..	$4\frac{1}{2}$	5	5	$5\frac{1}{2}$	6	6		
		Bulb angle frames..	$6\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot36$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot36$		
22	24	Frames..	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	
		Reversed frames ..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\times3\times\cdot36$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	
		Depth of framing ..	$4\frac{1}{2}$	5	$5\frac{1}{2}$	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$	
		Bulb angle frames..	$6\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot36$	$7\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$	
23	$24\frac{1}{2}$	Frames..	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot34$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot36$	$5\times3\times\cdot36$
		Reversed frames ..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot36$
		Depth of framing ..	5	$5\frac{1}{2}$	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$	7	$7\frac{1}{2}$
		Bulb angle frames..	$6\frac{1}{2}\times3\times\cdot38$	$7\times3\times\cdot36$	$7\times3\times\cdot40$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$	$8\times3\times\cdot42$	$8\frac{1}{2}\times3\times\cdot38$
24	25	Frames..	$4\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot32$	$5\times3\times\cdot34$	$5\times3\times\cdot34$	$5\times3\times\cdot36$	$5\times3\times\cdot38$	$5\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot38$
		Reversed frames ..	$3\times3\times\cdot36$	$3\frac{1}{2}\times3\times\cdot32$	$3\frac{1}{2}\times3\times\cdot34$	$4\times3\times\cdot34$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot38$	$5\times3\times\cdot38$	$5\times3\times\cdot38$
		Depth of framing ..	5	6	6	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	7	$7\frac{1}{2}$
		Bulb angle frames..	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot40$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot46$	$8\times3\times\cdot38$	$8\times3\times\cdot46$	$8\frac{1}{2}\times3\times\cdot44$
25	$25\frac{1}{2}$	Frames..	$5\times3\times\cdot34$	$5\times3\times\cdot34$	$5\times3\times\cdot36$	$5\times3\times\cdot36$	$5\times3\times\cdot38$	$5\times3\times\cdot38$	$5\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot40$
		Reversed frames ..	$3\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot34$	$3\frac{1}{2}\times3\times\cdot36$	$4\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot38$	$5\times3\times\cdot38$	$5\times3\times\cdot40$	$5\times3\times\cdot40$
		Depth of framing ..	$5\frac{1}{2}$	6	6	$6\frac{1}{2}$	$6\frac{1}{2}$	7	7	$7\frac{1}{2}$
		Bulb angle frames..	$7\times3\times\cdot36$	$7\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot36$	$7\frac{1}{2}\times3\times\cdot46$	$8\times3\times\cdot38$	$8\times3\times\cdot46$	$8\times3\times\cdot52$	$8\frac{1}{2}\times3\times\cdot48$

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.							
			Feet. 17	Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches	Inches.	Inches.
18	23	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
19	$23\frac{1}{2}$	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
20	$23\frac{1}{2}$	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
21	24	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
22	24	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
23	$24\frac{1}{2}$	Frames..								
		Reversed frames ..								
		Depth of framing ..								
		Bulb angle frames..								
24	25	Frames..	$5\frac{1}{2} \times 3 \times \cdot 38$							
		Reversed frames ..	$5\frac{1}{2} \times 3 \times \cdot 38$							
		Depth of framing ..	8							
		Bulb angle frames..	$8\frac{1}{2} \times 3 \times \cdot 52$							
25	$25\frac{1}{2}$	Frames..	$5\frac{1}{2} \times 3 \times \cdot 40$	$6 \times 3 \times \cdot 40$						
		Reversed frames ..	$5\frac{1}{2} \times 3 \times \cdot 40$	$5\frac{1}{2} \times 3 \times \cdot 40$						
		Depth of framing ..	8	$8\frac{1}{2}$						
		Bulb angle frames..	$9 \times 3 \times \cdot 42$	$9 \times 3 \times \cdot 52$						

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.						
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames..	5 × 3 × ·36	5 × 3½ × ·36	5 × 3½ × ·36	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·38	5½ × 3½ × ·38
		Reversed frames ..	3 × 3 × ·36	3 × 3½ × ·36	3½ × 3½ × ·36	4 × 3½ × ·38	4½ × 3½ × ·38	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·38
		Depth of framing ..	5½	5½	6	6	6½	6½	7	7½
		Bulb angle frames..	7 × 3 × ·40	7½ × 3½ × ·36	7½ × 3½ × ·46	8 × 3½ × ·38	8 × 3½ × ·46	8 × 3½ × ·46	8½ × 3½ × ·42	8½ × 3½ × ·52
27	26½	Frames..	5 × 3 × ·38	5 × 3½ × ·36	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5½ × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·38	3½ × 3½ × ·36	4 × 3½ × ·38	4 × 3½ × ·40	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·40
		Depth of framing ..	5½	6	6	6	6½	7	7	7½
		Bulb angle frames..	7 × 3 × ·44	7½ × 3½ × ·46	8 × 3½ × ·38	8 × 3½ × ·42	8 × 3½ × ·46	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·44
28	27	Frames..	5½ × 3½ × ·36	5½ × 3½ × ·38	5½ × 3½ × ·38	5½ × 3½ × ·38	5½ × 3½ × ·38	5½ × 3½ × ·40	5½ × 3½ × ·40	5½ × 3½ × ·40
		Reversed frames ..	3 × 3 × ·36	3½ × 3½ × ·38	4 × 3½ × ·38	4 × 3½ × ·38	4½ × 3½ × ·38	4½ × 3½ × ·40	5 × 3½ × ·40	5½ × 3½ × ·40
		Depth of framing ..	6	6	6½	6½	7	7	7½	8
		Bulb angle frames..	7½ × 3½ × ·36	8 × 3½ × ·38	8 × 3½ × ·46	8 × 3½ × ·46	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·44	9½ × 3½ × ·42
29	27½	Frames..	5½ × 3½ × ·38	5½ × 3½ × ·40	5½ × 3½ × ·38	5½ × 3½ × ·38	5½ × 3½ × ·40	6 × 3½ × ·38	6 × 3½ × ·38	6 × 3½ × ·38
		Reversed frames ..	3½ × 3 × ·38	3½ × 3½ × ·40	4 × 3½ × ·38	4½ × 3½ × ·38	4½ × 3½ × ·40	4½ × 3½ × ·38	5 × 3½ × ·38	5½ × 3½ × ·38
		Depth of framing ..	6	6	6½	7	7	7½	8	8½
		Bulb angle frames..	7½ × 3½ × ·40	8 × 3½ × ·42	8 × 3½ × ·46	8½ × 3½ × ·42	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·48	9½ × 3½ × ·44
30	28	Frames..	5½ × 3½ × ·40	5½ × 3½ × ·40	5½ × 3½ × ·38	5½ × 3½ × ·40	6 × 3½ × ·38	6 × 3½ × ·38	6 × 3½ × ·40	9 × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·40	4 × 3½ × ·40	4½ × 3½ × ·38	4½ × 3½ × ·40	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5½ × 3½ × ·40
		Depth of framing ..	6	6½	7	7	7½	8	8	8½
		Bulb angle frames..	7½ × 3½ × ·44	8 × 3½ × ·50	8½ × 3½ × ·42	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·48	9½ × 3½ × ·42	9½ × 3½ × ·48
31	28½	Frames..	6 × 3½ × ·40	6 × 3½ × ·38	6 × 3½ × ·40	6 × 3½ × ·38	6 × 3½ × ·40	6 × 3½ × ·40	6 × 3½ × ·40	6 × 3½ × ·38
		Reversed frames ..	3½ × 3 × ·40	4 × 3½ × ·38	4 × 3½ × ·40	4½ × 3½ × ·38	4½ × 3½ × ·40	5 × 3½ × ·40	5½ × 3½ × ·40	6 × 3½ × ·38
		Depth of framing ..	6½	7	7	7½	7½	8	8½	9
		Bulb angle frames..	8 × 3½ × ·40	8½ × 3½ × ·42	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·44	9½ × 3½ × ·42	9½ × 3½ × ·48	9½ × 3½ × ·52
32	29	Frames..	6 × 3½ × 42	6 × 3½ × ·38	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·42	6½ × 3½ × ·38	6½ × 3½ × ·38
		Reversed frames ..	3½ × 3 × ·42	4½ × 3½ × ·38	4½ × 3½ × ·40	4½ × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·42	5½ × 3½ × ·38	6 × 3½ × ·38
		Depth of framing ..	6½	7½	7½	7½	8	8	9	9½
		Bulb angle frames..	8 × 3½ × ·44	8½ × 3½ × ·52	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·42	9½ × 3½ × ·46	9½ × 3½ × ·52	10 × 3½ × ·48

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.							
			Feet. 17	Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot38$	$6\times3\frac{1}{2}\times\cdot38$						
		Reversed frames..	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot38$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot38$						
		Depth of framing	8	$8\frac{1}{2}$						
		Bulb angle frames	$9\times3\frac{1}{2}\times\cdot48$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot44$						
27	$26\frac{1}{2}$	Frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot42$					
		Reversed frames..	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot42$					
		Depth of framing	8	$8\frac{1}{2}$	9					
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$10\times3\frac{1}{2}\times\cdot50$					
28	27	Frames	$6\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot40$				
		Reversed frames	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot40$				
		Depth of framing	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10				
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$10\times3\frac{1}{2}\times\cdot46$	$10\times3\frac{1}{2}\times\cdot54$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot48$				
29	$27\frac{1}{2}$	Frames	$6\times3\frac{1}{2}\times\cdot38$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot38$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot44$			
		Reversed frames..	$6\times3\frac{1}{2}\times\cdot38$	$6\times3\frac{1}{2}\times\cdot38$	$6\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$			
		Depth of framing	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10	$10\frac{1}{2}$			
		Bulb angle frames	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$10\times3\frac{1}{2}\times\cdot48$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$11\times3\frac{1}{2}\times\cdot54$			
30	28	Frames	$6\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$7\times3\frac{1}{2}\times\cdot42$	$7\times3\frac{1}{2}\times\cdot46$	$7\times3\frac{1}{2}\times\cdot46$		
		Reversed frames..	$6\times3\frac{1}{2}\times\cdot40$	$6\times3\frac{1}{2}\times\cdot40$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$7\times3\frac{1}{2}\times\cdot46$		
		Depth of framing	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$	$10\frac{1}{2}$	11		
		Bulb angle frames	$10\times3\frac{1}{2}\times\cdot46$	$10\times3\frac{1}{2}\times\cdot54$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$11\times3\frac{1}{2}\times\cdot50$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot54$		
31	$28\frac{1}{2}$	Frames	$6\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot46$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	
		Reversed frames..	$6\times3\frac{1}{2}\times\cdot42$	$6\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot46$	$7\times3\frac{1}{2}\times\cdot46$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	
		Depth of framing	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	12	
		Bulb angle frames	$10\times3\frac{1}{2}\times\cdot50$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$11\times3\frac{1}{2}\times\cdot54$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$12\times3\frac{1}{2}\times\cdot52$	$12\times3\frac{1}{2}\times\cdot66$	
32	29	Frames	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot38$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$7\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot44$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\frac{1}{2}\times3\frac{1}{2}\times46$	$8\times3\frac{1}{2}\times\cdot46$	$8\times3\frac{1}{2}\times\cdot48$
		Reversed frames..	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot38$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot44$	$7\times3\frac{1}{2}\times\cdot44$	$7\frac{1}{2}\times3\frac{1}{2}\times46$	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$8\times3\frac{1}{2}\times\cdot48$
		Depth of framing	10	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	12	$12\frac{1}{2}$	13
		Bulb angle or channel frames	$10\times3\frac{1}{2}\times\cdot56$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$11\times3\frac{1}{2}\times\cdot54$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$12\times3\frac{1}{2}\times\cdot48$	$12\times3\frac{1}{2}\times\cdot60$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$12\times4\times4\times\cdot50$

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42	6½ × 3½ × ·38
		Reversed frames ..	3½ × 3 × ·42	4 × 3½ × ·40	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·42	5½ × 3½ × ·38
		Depth of framing..	7	7½	7½	8	8	9
		Bulb angle frames..	8½ × 3½ × ·42	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·42	9½ × 3½ × ·46	9½ × 3½ × ·52
34	30	Frames	7 × 3½ × ·42	7 × 3½ × ·44	7 × 3½ × ·40	7 × 3½ × ·40	7 × 3½ × ·38	7 × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·42	3½ × 3½ × ·44	4 × 3½ × ·40	4½ × 3½ × ·40	5 × 3½ × ·38	5 × 3½ × ·40
		Depth of framing..	7½	7½	8	8½	9	9
		Bulb angle frames..	8½ × 3½ × ·52	9 × 3½ × ·52	9½ × 3½ × ·42	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·46
35	30½	Frames	7½ × 3½ × ·42	7½ × 3½ × ·42	7½ × 3½ × ·40	7½ × 3½ × ·38	7½ × 3½ × ·40	7½ × 3½ × ·38
		Reversed frames ..	3½ × 3 × ·42	3½ × 3½ × ·42	4 × 3½ × ·40	4½ × 3½ × ·38	4½ × 3½ × ·40	5 × 3½ × ·38
		Depth of framing..	8	8	8½	9	9	9½
		Bulb angle frames..	9 × 3½ × ·46	9½ × 3½ × ·46	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·46	10 × 3½ × ·48
36	31	Frames	7½ × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·38	8 × 3½ × ·40	8 × 3½ × ·38	8 × 3½ × ·40
		Reversed frames ..	3½ × 3½ × ·42	3½ × 3½ × ·40	4 × 3½ × ·38	4 × 3½ × ·40	4½ × 3½ × ·38	4½ × 3½ × ·40
		Depth of framing..	8	8½	9	9	9½	9½
		Bulb angle frames..	9½ × 3½ × ·46	9½ × 3½ × ·48	9½ × 3½ × ·52	10 × 3½ × ·46	10 × 3½ × ·48	10 × 3½ × ·54
37	31½	Frames	8 × 3½ × ·42	8 × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·40	8 × 3½ × ·42	8 × 3½ × ·40
		Reversed frames ..	3½ × 3½ × ·42	3½ × 3½ × ·42	4 × 3½ × ·40	4½ × 3½ × ·40	4½ × 3½ × ·42	5 × 3½ × ·40
		Depth of framing..	8½	8½	9	9½	9½	10
		Bulb angle frames..	9½ × 3½ × ·52	9½ × 3½ × ·52	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·46	10½ × 3½ × ·48
38	32	Frames	8 × 3½ × ·42	8 × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·44
		Reversed frames ..	4 × 3½ × ·42	4 × 3½ × ·42	4½ × 3½ × ·40	4½ × 3½ × ·42	4½ × 3½ × ·44	5 × 3½ × ·44
		Depth of framing..	9	9	9½	9½	9½	10
		Bulb angle frames..	10 × 3½ × ·50	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·58
39	32½	Frames	8 × 3½ × ·44	8 × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·42
		Reversed frames ..	4 × 3½ × ·44	4½ × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·42	5 × 3½ × ·44	5½ × 3½ × ·42
		Depth of framing..	9	9½	10	10	10	10½
		Bulb angle frames..	10 × 3½ × ·54	10½ × 3½ × ·46	10½ × 3½ × ·48	10½ × 3½ × ·52	10½ × 3½ × ·58	11 × 3½ × ·50

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	6½ × 3½ × ·40	6½ × 3½ × ·40	6½ × 3½ × ·40	6½ × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·46
		Reversed frames ..	5½ × 3½ × ·40	6 × 3½ × ·40	6½ × 3½ × ·40	6½ × 3½ × ·44	6½ × 3½ × ·46	7 × 3½ × ·46
		Depth of framing ..	9	9½	10	10	10½	11
		Bulb angle frames..	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·48	10½ × 3½ × ·58	11½ × 3½ × ·48	11½ × 3½ × ·54
34	30	Frames	7 × 3½ × ·38	7 × 3½ × ·38	7 × 3½ × ·42	7 × 3½ × ·44	7½ × 3½ × ·44	7½ × 3½ × ·46
		Reversed frames ..	5½ × 3½ × ·38	6 × 3½ × ·38	6 × 3½ × ·42	6½ × 3½ × ·44	6½ × 3½ × ·44	7 × 3½ × ·46
		Depth of framing ..	9½	10	10	10½	11	11½
		Bulb angle frames..	10 × 3½ × ·48	10 × 3½ × ·56	10½ × 3½ × ·52	11 × 3½ × ·54	11½ × 3½ × ·50	12 × 3½ × ·52
35	30½	Frames	8 × 3½ × ·38	8 × 3½ × ·42	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·48
		Reversed frames ..	5 × 3½ × ·38	5 × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·48
		Depth of framing ..	10	10	10½	10½	11	11½
		Bulb angle frames..	10 × 3½ × ·56	10½ × 3½ × ·52	11 × 3½ × ·50	11½ × 3½ × ·48	11½ × 3½ × ·54	12 × 3½ × ·56
36	31	Frames	8 × 3½ × ·40	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·50
		Reversed frames ..	5 × 3½ × ·40	5 × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·50
		Depth of framing ..	10	10	10½	11	11½	11½
		Bulb angle frames..	10½ × 3½ × ·48	10½ × 3½ × ·58	11 × 3½ × ·54	11½ × 3½ × ·54	12 × 3½ × ·52	12 × 3½ × ·62
37	31½	Frames	8 × 3½ × ·40	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·50
		Reversed frames ..	5½ × 3½ × ·40	5½ × 3½ × ·42	6 × 3½ × ·44	6½ × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·50
		Depth of framing ..	10½	10½	11	11½	12	12
		Bulb angle or channel frames	10½ × 3½ × ·56	11 × 3½ × ·58	11½ × 3½ × ·50	12 × 3½ × ·48	12 × 3½ × ·60	12 × 3½ × 3½ × ·52
38	32	Frames	8 × 3½ × ·42	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·52
		Reversed frames ..	5½ × 3½ × ·42	6 × 3½ × ·42	6 × 3½ × ·46	6½ × 3½ × ·46	7 × 3½ × ·48	7½ × 3½ × ·52
		Depth of framing ..	10½	11	11	11½	12	12
		Bulb angle or channel frames	11 × 3½ × ·50	11½ × 3½ × ·48	11½ × 3½ × ·54	12 × 3½ × ·52	12 × 3½ × ·66	12 × 3½ × 3½ × ·56
39	32½	Frames	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·50	8 × 3½ × ·52
		Reversed frames ..	6 × 3½ × ·42	6 × 3½ × ·44	6½ × 3½ × ·46	7 × 3½ × ·46	7 × 3½ × ·50	8 × 3½ × ·52
		Depth of framing ..	11	11	11½	12	12	12½
		Bulb angle or channel frames	11½ × 3½ × ·48	11½ × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·60	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A

(SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	7½ × 3½ × ·46	7½ × 3½ × ·48	8 × 3½ × ·46	8 × 3½ × ·50		
		Reversed frames ..	7 × 3½ × ·46	7½ × 3½ × ·48	8 × 3½ × ·46	8 × 3½ × ·50		
		Depth of framing..	11½	12	13	13		
		Bulb angle or channel frames	12 × 3½ × ·52	12 × 3½ × ·66	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·54		
34	30	Frames	7½ × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·48	8½ × 3½ × ·52	9 × 4 × ·54	
		Reversed frames ..	7½ × 3½ × ·46	7½ × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·52	8 × 3½ × ·54	
		Depth of framing..	12	12½	13	13	13½	
		Bulb angle or channel frames	12 × 3½ × ·60	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·50	12 × 4 × 4 × ·58	13 × 4 × 4 × ·54	
35	30½	Frames	8 × 3½ × ·48	8 × 3½ × ·50	8½ × 3½ × ·52	9 × 4 × ·52	9 × 4 × ·56	9 × 4 × ·56
		Reversed frames ..	7 × 3½ × ·48	7½ × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·56	8½ × 3½ × ·56
		Depth of framing..	12	12½	13	13½	13½	14
		Bulb angle or channel frames	12 × 3½ × ·66	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52
36	31	Frames	8 × 3½ × ·52	8 × 3½ × ·52	8½ × 3½ × ·54	9 × 4 × ·54	9 × 4 × ·56	9 × 4 × ·60
		Reversed frames ..	7½ × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·54	8 × 3½ × ·54	8½ × 3½ × ·56	8½ × 3½ × ·60
		Depth of framing..	12	12½	13	13½	14	14
		Channel frames ..	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54	14 × 4 × 4 × ·52	14 × 4 × 4 × ·58
37	31½	Frames	8 × 3½ × ·54	8½ × 3½ × ·52	8½ × 3½ × ·52	9 × 4 × ·56	9 × 4 × ·58	9½ × 4 × ·54
		Reversed frames ..	7½ × 3½ × ·54	8 × 3½ × ·52	8½ × 3½ × ·52	8 × 3½ × ·56	8½ × 3½ × ·58	8½ × 4 × ·54
		Depth of framing..	12	13	13½	13½	14	14½
		Channel frames ..	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58	14 × 4 × 4 × ·56	15 × 4 × 4 × ·52
38	32	Frames	8 × 3½ × ·54	8½ × 3½ × ·54	8½ × 3½ × ·56	9 × 4 × ·56	9½ × 4 × ·52	9½ × 4 × ·58
		Reversed frames ..	8 × 3½ × ·54	8 × 3½ × ·54	8½ × 3½ × ·56	8½ × 3½ × ·56	8½ × 4 × ·52	8½ × 4 × ·58
		Depth of framing..	12½	13	13½	14	14½	14½
		Channel frames ..	12 × 4 × 4 × ·56	13 × 4 × 4 × ·50	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52	14 × 4 × 4 × ·58	15 × 4 × 4 × ·56
39	32½	Frames	8½ × 3½ × ·52	8½ × 3½ × ·54	9 × 4 × ·54	9 × 4 × ·58	9½ × 4 × ·56	9½ × 4 × ·60
		Reversed frames ..	8 × 3½ × ·52	8½ × 3½ × ·54	8½ × 3½ × ·54	8½ × 3½ × ·58	8½ × 4 × ·56	8½ × 4 × ·60
		Depth of framing..	13	13½	14	14	14½	14½
		Channel frames ..	12 × 4 × 4 × ·58	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62	14 × 4 × 4 × ·56	15 × 4 × 4 × ·54	15 × 4 × 4 × ·58

SIDE FRAMING.

TABLE 3A

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES. (SEE CONTINUATION.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44
		Reversed frames ..	4 × 3½ × ·46	4½ × 3½ × ·44	5 × 3½ × ·42	5 × 3½ × ·44	5 × 3½ × ·46	5½ × 3½ × ·44
		Depth of framing ..	9	9½	10	10	10	10½
		Bulb angle frames ..	10½ × 3½ × ·48	10½ × 3½ × ·48	10½ × 3½ × ·52	10½ × 3½ × ·58	11 × 3½ × ·50	11 × 3½ × ·54
41	33½	Frames	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44
		Reversed frames ..	4½ × 3½ × ·44	5 × 3½ × ·44	5½ × 3½ × ·42	5½ × 3½ × ·44	5½ × 3½ × ·46	6 × 3½ × ·44
		Depth of framing ..	9½	10	10½	10½	10½	11
		Bulb angle frames ..	10½ × 3½ × ·50	10½ × 3½ × ·58	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·48	11½ × 3½ × ·50
42	34	Frames	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44
		Reversed frames ..	4½ × 3½ × ·46	5½ × 3½ × ·44	5½ × 3½ × ·46	6 × 3½ × ·44	6 × 3½ × ·46	6½ × 3½ × ·44
		Depth of framing ..	9½	10½	10½	11	11	11½
		Bulb angle frames ..	10½ × 3½ × ·54	11 × 3½ × ·54	11½ × 3½ × ·48	11½ × 3½ × ·50	11½ × 3½ × ·54	12 × 3½ × ·48
43	34½	Frames	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44
		Reversed frames ..	5 × 3½ × ·46	6 × 3½ × ·44	6 × 3½ × ·46	6½ × 3½ × ·44	6½ × 3½ × ·46	7 × 3½ × ·44
		Depth of framing ..	10	11	11	11½	11½	12
		Bulb angle frames ..	11 × 3½ × ·50	11½ × 3½ × ·50	11½ × 3½ × ·54	12 × 3½ × ·48	12 × 3½ × ·52	12 × 3½ × ·56
44	35	Frames	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·46
		Reversed frames ..	5½ × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·48	6½ × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·46
		Depth of framing ..	10½	11	11	11½	11½	12
		Bulb angle frames ..	11½ × 3½ × ·48	11½ × 3½ × ·54	12 × 3½ × ·48	12 × 3½ × ·52	12 × 3½ × ·56	12 × 3½ × ·60
45	35½	Frames	8 × 3½ × ·48	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·46
		Reversed frames ..	5½ × 3½ × ·48	6½ × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·46	7 × 3½ × ·48	7½ × 3½ × ·46
		Depth of framing ..	10½	11½	11½	12	12	12½
		Bulb angle or channel frames ..	11½ × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·56	12 × 3½ × ·60	12 × 3½ × ·66	12 × 3½ × 3½ × ·50
46	36	Frames	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·48	8 × 3½ × ·50
		Reversed frames ..	6 × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·50	7½ × 3½ × ·48	7½ × 3½ × ·50
		Depth of framing ..	11	11½	12	12	12½	12½
		Bulb angle or channel frames ..	11½ × 3½ × ·60	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·54	12 × 3½ × 3½ × ·58

SIDE FRAMING.

TABLE 3A

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES. *(SEE CONTINUATION.)*

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches	Inches.
40	33	Frames	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·54
		Reversed frames	6 × 3½ × ·44	6½ × 3½ × ·44	6½ × 3½ × ·48	7 × 3½ × ·48	7½ × 3½ × ·50	8 × 3½ × ·54
		Depth of framing	11	11½	11½	12	12½	12½
		Bulb angle or channel frames	11½ × 3½ × ·50	12 × 3½ × ·48	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·56
41	33½	Frames	8 × 3½ × ·44	8 × 3½ × ·44	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·52	8½ × 3½ × ·54
		Reversed frames	6½ × 3½ × ·44	7 × 3½ × ·44	7 × 3½ × ·48	7½ × 3½ × ·48	8 × 3½ × ·52	8 × 3½ × ·54
		Depth of framing	11½	12	12	12½	12½	13
		Bulb angle or channel frames	12 × 3½ × ·48	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50
42	34	Frames	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·52	9 × 4 × ·52
		Reversed frames	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·50	7½ × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·52
		Depth of framing	12	12	12	12½	13	13½
		Bulb angle or channel frames	12 × 3½ × ·56	12 × 3½ × ·60	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52
43	34½	Frames	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·52	9 × 4 × ·52
		Reversed frames	7 × 3½ × ·46	7½ × 3½ × ·46	7½ × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·52	8½ × 3½ × ·52
		Depth of framing	12	12½	12½	13	13½	14
		Bulb angle or channel frames	12 × 3½ × ·60	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·54	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58
44	35	Frames	8 × 3½ × ·48	8 × 3½ × ·48	8½ × 3½ × ·48	8½ × 3½ × ·50	9 × 4 × ·50	9 × 4 × ·54
		Reversed frames	7 × 3½ × ·48	7½ × 3½ × ·48	7½ × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·54
		Depth of framing	12	12½	13	13½	14	14
		Bulb angle or channel frames	12 × 3½ × ·66	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·50	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54	13 × 4 × 4 × ·62
45	35½	Frames	8 × 3½ × ·48	8 × 3½ × ·48	8½ × 3½ × ·48	9 × 4 × ·52	9 × 4 × ·52	9 × 4 × ·56
		Reversed frames	7½ × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·52	8½ × 4 × ·52	8½ × 3½ × ·56
		Depth of framing	12½	13	13½	13½	14	14
		Channel frames	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·50	12 × 4 × 4 × ·58	13 × 4 × 4 × ·52	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52
46	36	Frames	8½ × 3½ × ·48	8½ × 3½ × ·48	9 × 4 × ·48	9 × 4 × ·52	9 × 4 × ·56	9½ × 4 × ·52
		Reversed frames	7½ × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·48	8½ × 3½ × ·52	8½ × 4 × ·56	8½ × 4 × ·52
		Depth of framing	13	13½	14	14	14	14½
		Channel frames	12 × 4 × 4 × ·50	12 × 4 × 4 × ·58	13 × 4 × 4 × ·50	13 × 4 × 4 × ·58	14 × 4 × 4 × ·52	14 × 4 × 4 × ·58

SIDE FRAMING.

FULL SCANTLING VESSELS WITH 100 PER CENT. SUPERSTRUCTURES.

TABLE 3A (CONCLUDED.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot56$	$9\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot52$	$9\frac{1}{2}\times4\times\cdot58$	$9\frac{1}{2}\times4\times\cdot62$
		Reversed frames	$8\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot56$	$8\frac{1}{2}\times4\times\cdot56$	$8\frac{1}{2}\times4\times\cdot52$	$8\frac{1}{2}\times4\times\cdot58$	$8\frac{1}{2}\times4\times\cdot62$
		Depth of framing	13	$13\frac{1}{2}$	14	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$
		Channel frames	$13\times4\times4\times\cdot50$	$13\times4\times4\times\cdot58$	$14\times4\times4\times\cdot52$	$14\times4\times4\times\cdot58$	$15\times4\times4\times\cdot56$	$15\times4\times4\times\cdot62$
41	$33\frac{1}{2}$	Frames	$9\times4\times\cdot54$	$9\times4\times\cdot54$	$9\frac{1}{2}\times4\times\cdot52$	$9\frac{1}{2}\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot60$	$9\frac{1}{2}\times4\times\cdot66$
		Reversed frames	$8\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times4\times\cdot52$	$8\frac{1}{2}\times4\times\cdot56$	$8\frac{1}{2}\times4\times\cdot60$	$8\frac{1}{2}\times4\times\cdot66$
		Depth of framing	$13\frac{1}{2}$	14	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$
		Channel frames	$13\times4\times4\times\cdot54$	$13\times4\times4\times\cdot62$	$14\times4\times4\times\cdot58$	$15\times4\times4\times\cdot54$	$15\times4\times4\times\cdot58$	$15\times4\times4\times\cdot66$
42	34	Frames	$9\times4\times\cdot54$	$9\times4\times\cdot58$	$9\frac{1}{2}\times4\times\cdot54$	$9\frac{1}{2}\times4\times\cdot58$	$9\frac{1}{2}\times4\times\cdot64$	
		Reversed frames	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times4\times\cdot58$	$8\frac{1}{2}\times4\times\cdot54$	$8\frac{1}{2}\times4\times\cdot58$	$8\frac{1}{2}\times4\times\cdot64$	
		Depth of framing	14	14	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$	
		Channel frames	$13\times4\times4\times\cdot62$	$14\times4\times4\times\cdot56$	$15\times4\times4\times\cdot52$	$15\times4\times4\times\cdot56$	$15\times4\times4\times\cdot64$	
43	$34\frac{1}{2}$	Frames	$9\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot52$	$9\frac{1}{2}\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot62$		
		Reversed frames	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot56$	$8\frac{1}{2}\times4\times\cdot52$	$8\frac{1}{2}\times4\times\cdot56$	$8\frac{1}{2}\times4\times\cdot62$		
		Depth of framing	14	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$		
		Channel frames	$14\times4\times4\times\cdot52$	$14\times4\times4\times\cdot58$	$15\times4\times4\times\cdot54$	$15\times4\times4\times\cdot62$		
44	35	Frames	$9\times4\times\cdot58$	$9\frac{1}{2}\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot60$	$9\frac{1}{2}\times4\times\cdot66$		
		Reversed frames	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$8\frac{1}{2}\times4\times\cdot56$	$8\frac{1}{2}\times4\times\cdot60$	$8\frac{1}{2}\times4\times\cdot66$		
		Depth of framing	14	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$		
		Channel frames	$14\times4\times4\times\cdot56$	$15\times4\times4\times\cdot54$	$15\times4\times4\times\cdot58$	$15\times4\times4\times\cdot66$		
45	$35\frac{1}{2}$	Frames	$9\frac{1}{2}\times4\times\cdot52$	$9\frac{1}{2}\times4\times\cdot58$	$9\frac{1}{2}\times4\times\cdot62$			
		Reversed frames	$8\frac{1}{2}\times4\times\cdot52$	$8\frac{1}{2}\times4\times\cdot58$	$8\frac{1}{2}\times4\times\cdot62$			
		Depth of framing	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$			
		Channel frames	$14\times4\times4\times\cdot58$	$15\times4\times4\times\cdot56$	$15\times4\times4\times\cdot62$			
46	36	Frames	$9\frac{1}{2}\times4\times\cdot56$	$9\frac{1}{2}\times4\times\cdot62$				
		Reversed frames	$8\frac{1}{2}\times4\times\cdot56$	$8\frac{1}{2}\times4\times\cdot62$				
		Depth of framing	$14\frac{1}{2}$	$14\frac{1}{2}$				
		Channel frames	$15\times4\times4\times\cdot54$	$15\times4\times4\times\cdot62$				

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.						
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18	23	Frames	3 × 3 × ·26	3 × 3 × ·26	3 × 3 × ·28					
		Reversed frames	2½ × 2½ × ·26	2½ × 2½ × ·26	2½ × 2½ × ·28					
		Depth of framing	3	3	3					
		Angle frames	5½ × 3 × ·32	5½ × 3 × ·32	5½ × 3 × ·34					
19	23½	Frames	3 × 3 × ·26	3 × 3 × ·26	3 × 3 × ·28	3 × 3 × ·28				
		Reversed frames	3 × 2½ × ·26	3 × 2½ × ·26	3 × 2½ × ·28	3 × 3 × ·28				
		Depth of framing	3½	3½	3½	3½				
		Angle frames	6 × 3 × ·32	6 × 3 × ·32	6 × 3 × ·34	6½ × 3 × ·34				
20	23½	Frames	3 × 3 × ·28	3 × 3 × ·28	3 × 3 × ·32	3 × 3 × ·30	3½ × 3 × ·30			
		Reversed frames	3 × 2½ × ·28	3 × 2½ × ·28	3 × 2½ × ·32	3 × 3 × ·30	3 × 3 × ·30			
		Depth of framing	3½	3½	3½	3½	4			
		Angle or bulb angle frames	6 × 3 × ·34	6 × 3 × ·34	6½ × 3 × ·32	6½ × 3 × ·38	5½ × 3 × ·34			
21	24	Frames	3 × 3 × ·28	3 × 3 × ·28	3 × 3 × ·32	3½ × 3 × ·30	3½ × 3 × ·30	3½ × 3 × ·32		
		Reversed frames	3 × 3 × ·28	3 × 3 × ·28	3 × 3 × ·32	3 × 3 × ·30	3½ × 3 × ·30	3½ × 3 × ·32		
		Depth of framing	3½	3½	3½	4	4½	4½		
		Angle or bulb angle frames	6½ × 3 × ·34	6½ × 3 × ·34	5½ × 3 × ·28	5½ × 3 × ·34	6 × 3 × ·32	6 × 3 × ·38		
22	24	Frames	3 × 3 × ·30	3 × 3 × ·32	3 × 3 × ·34	3½ × 3 × ·32	3½ × 3 × ·32	3½ × 3 × ·34	4 × 3 × ·34	
		Reversed frames	3 × 3 × ·30	3 × 3 × ·32	3 × 3 × ·34	3 × 3 × ·32	3½ × 3 × ·32	3½ × 3 × ·34	3½ × 3 × ·34	
		Depth of framing	3½	3½	3½	4	4½	4½	5	
		Angle or bulb angle frames	6½ × 3 × ·38	5½ × 3 × ·28	5½ × 3 × ·32	5½ × 3 × ·40	6 × 3 × ·38	6 × 3 × ·42	6½ × 3 × ·38	
23	24½	Frames	3 × 3 × ·32	3½ × 3 × ·32	3½ × 3 × ·34	4 × 3 × ·32	4 × 3 × ·32	4 × 3 × ·34	4 × 3 × ·34	4½ × 3 × ·34
		Reversed frames	3 × 3 × ·32	3 × 3 × ·32	3 × 3 × ·34	3 × 3 × ·32	3½ × 3 × ·32	3½ × 3 × ·34	4 × 3 × ·34	4 × 3 × ·34
		Depth of framing	3½	4	4	4½	5	5	5½	6
		Bulb angle frames	5½ × 3 × ·28	5½ × 3 × ·40	6 × 3 × ·30	6 × 3 × ·38	6½ × 3 × ·34	6½ × 3 × ·38	7 × 3 × ·36	7 × 3 × ·46
24	25	Frames	3 × 3 × ·32	3½ × 3 × ·34	3½ × 3 × ·36	4 × 3 × ·34	4 × 3 × ·34	4 × 3 × ·36	4 × 3 × ·36	4½ × 3 × ·36
		Reversed frames	3 × 3 × ·32	3 × 3 × ·34	3 × 3 × ·36	3 × 3 × ·34	3½ × 3 × ·34	3½ × 3 × ·36	4 × 3 × ·36	4 × 3 × ·36
		Depth of framing	3½	4	4	4½	5	5	5½	6
		Bulb angle frames	5½ × 3 × ·28	6 × 3 × ·30	6 × 3 × ·34	6 × 3 × ·42	6½ × 3 × ·38	6½ × 3 × ·44	7 × 3 × ·40	7½ × 3 × ·36
25	25½	Frames	3 × 3 × ·34	3½ × 3 × ·34	3½ × 3 × ·36	4 × 3 × ·34	4 × 3 × ·34	4 × 3 × ·36	4½ × 3 × ·36	4½ × 3 × ·40
		Reversed frames	3 × 3 × ·34	3½ × 3 × ·34	3½ × 3 × ·36	3½ × 3 × ·34	4 × 3 × ·34	4 × 3 × ·36	4 × 3 × ·36	4½ × 3 × ·40
		Depth of framing	3½	4½	4½	5	5½	5½	6	6
		Bulb angle frames	5½ × 3 × ·32	6 × 3 × ·42	6½ × 3 × ·32	6½ × 3 × ·38	7 × 3 × ·36	7 × 3 × ·40	7½ × 3 × ·36	7½ × 3 × ·44

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.								
			Feet. 17	Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18	23	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Angle frames									
19	23½	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Angle frames									
20	23½	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Angle or bulb angle frames									
21	24	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Angle or bulb angle frames									
22	24	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Bulb angle frames									
23	24½	Frames									
		Reversed frames ..									
		Depth of framing ..									
		Bulb angle frames									
24	25	Frames	4½ × 3 × ·40								
		Reversed frames ..	4½ × 3 × ·40								
		Depth of framing ..	6								
		Bulb angle frames	7½ × 3 × ·44								
25	25½	Frames	5 × 3 × ·40	5 × 3 × ·40							
		Reversed frames ..	4½ × 3 × ·40	5 × 3 × ·40							
		Depth of framing ..	6½	7							
		Bulb angle frames	8 × 3 × ·40	8 × 3 × ·52							

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.						
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames	3½ × 3 × ·30	3½ × 3 × ·36	4 × 3 × ·34	4 × 3 × ·36	4½ × 3 × ·36	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·42
		Reversed frames ..	3 × 3 × ·30	3½ × 3 × ·36	3½ × 3 × ·34	3½ × 3 × ·36	3½ × 3 × ·36	4 × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·42
		Depth of framing ..	4	4½	5	5	5½	5½	6	6
		Bulb angle frames	5½ × 3 × ·34	6½ × 3 × ·32	6½ × 3 × ·38	6½ × 3 × ·44	7 × 3 × ·40	7 × 3 × ·44	7½ × 3 × ·40	8 × 3 × ·38
27	26½	Frames	3½ × 3 × ·32	4 × 3 × ·34	4 × 3 × ·36	4½ × 3 × ·34	4½ × 3 × ·36	4½ × 3 × ·38	5 × 3 × ·38	5 × 3 × ·42
		Reversed frames ..	3 × 3 × ·32	3½ × 3 × ·34	3½ × 3 × ·36	3½ × 3 × ·34	4 × 3 × ·36	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·42
		Depth of framing ..	4	5	5	5½	6	6	6½	6½
		Bulb angle frames	5½ × 3 × ·40	6½ × 3 × ·38	6½ × 3 × ·44	7 × 3 × ·36	7½ × 3 × ·36	7½ × 3 × ·40	8 × 3 × ·38	8 × 3 × ·44
28	27	Frames	3½ × 3 × ·34	4 × 3 × ·36	4 × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·40	5 × 3 × ·40	5 × 3 × ·44
		Reversed frames ..	3 × 3 × ·34	3½ × 3 × ·36	4 × 3 × ·38	4 × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·40	4½ × 3 × ·40	4½ × 3 × ·44
		Depth of framing ..	4	5	5	5½	6	6	6½	6½
		Bulb angle frames	6 × 3 × ·30	6½ × 3 × ·44	7 × 3 × ·36	7 × 3 × ·44	7½ × 3 × ·40	7½ × 3 × ·44	8 × 3 × ·40	8½ × 3 × ·38
29	27½	Frames	4 × 3 × ·32	4½ × 3½ × ·36	4½ × 3½ × ·38	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·42
		Reversed frames ..	3 × 3 × ·32	3½ × 3 × ·36	4 × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·38	5 × 3 × ·38	5 × 3 × ·42
		Depth of framing ..	4½	5½	5½	6	6½	6½	7	7
		Bulb angle frames	6 × 3 × ·38	7 × 3½ × ·40	7 × 3½ × ·44	7½ × 3½ × ·40	8 × 3½ × ·38	8 × 3½ × ·38	8 × 3½ × ·46	8½ × 3½ × ·42
30	28	Frames	4 × 3 × ·34	4½ × 3½ × ·38	4½ × 3½ × ·38	4½ × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44
		Reversed frames ..	3 × 3 × ·34	4 × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·38	4½ × 3 × ·40	5 × 3 × ·40	5 × 3 × ·44
		Depth of framing ..	4½	5½	6	6	6½	6½	7	7
		Bulb angle frames	6 × 3 × ·42	7 × 3½ × ·44	7½ × 3½ × ·40	7½ × 3½ × ·40	8 × 3½ × ·38	8 × 3½ × ·40	8½ × 3½ × ·38	8½ × 3½ × ·46
31	28½	Frames	4½ × 3 × ·34	4½ × 3½ × ·38	4½ × 3½ × ·40	4½ × 3½ × ·42	5 × 3½ × ·40	5 × 3½ × ·40	5 × 3½ × ·44	5½ × 3½ × ·44
		Reversed frames ..	3 × 3 × ·34	4½ × 3 × ·38	4½ × 3 × ·40	4½ × 3 × ·42	4½ × 3 × ·40	5 × 3 × ·40	5 × 3 × ·44	5 × 3 × ·44
		Depth of framing ..	5	6	6	6	6½	7	7	7½
		Bulb angle frames	6½ × 3 × ·38	7½ × 3½ × ·40	7½ × 3½ × ·44	8 × 3½ × ·38	8 × 3½ × ·40	8½ × 3½ × ·38	8½ × 3½ × ·46	9 × 3½ × ·42
32	29	Frames	4½ × 3 × ·36	4½ × 3½ × ·40	4½ × 3½ × ·42	4½ × 3½ × ·44	5 × 3½ × ·42	5 × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·46
		Reversed frames ..	3 × 3 × ·36	4½ × 3 × ·40	4½ × 3 × ·42	4½ × 3 × ·44	4½ × 3 × ·42	5 × 3 × ·42	5 × 3 × ·42	5 × 3 × ·46
		Depth of framing ..	5	6	6	6	6½	7	7½	7½
		Bulb angle frames	6½ × 3 × ·44	7½ × 3½ × ·44	8 × 3½ × ·38	8 × 3½ × ·40	8 × 3½ × ·44	8½ × 3½ × ·42	8½ × 3½ × ·52	9 × 3½ × ·46

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.								
			Feet. 17	Feet. 18	Feet. 19	Feet. 20	Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	26	Frames	5 × 3 × ·42	5 × 3 × ·42							
		Reversed frames ..	4½ × 3 × ·42	5 × 3 × ·42							
		Depth of framing ..	6½	7							
		Bulb angle frames	8 × 3 × ·44	8½ × 3 × ·42							
27	26½	Frames	5 × 3 × ·42	5½ × 3 × ·42	5½ × 3 × ·42						
		Reversed frames ..	5 × 3 × ·42	5 × 3 × ·42	5½ × 3 × ·42						
		Depth of framing ..	7	7½	8						
		Bulb angle frames	8½ × 3 × ·42	8½ × 3 × ·52	9 × 3 × ·46						
28	27	Frames	5 × 3 × ·44	5½ × 3 × ·44	5½ × 3 × ·46	6 × 3 × ·46					
		Reversed frames ..	5 × 3 × ·44	5 × 3 × ·44	5½ × 3 × ·46	5½ × 3 × ·46					
		Depth of framing ..	7	7½	8	8½					
		Bulb angle frames	8½ × 3 × ·46	9 × 3 × ·42	9½ × 3½ × ·44	9½ × 3½ × ·50					
29	27½	Frames	5½ × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·48	6 × 3½ × ·44	6 × 3½ × ·44				
		Reversed frames ..	5 × 3 × ·42	5½ × 3 × ·42	5½ × 3 × ·48	5½ × 3½ × ·44	6 × 3½ × ·44				
		Depth of framing ..	7½	8	8	8½	9				
		Bulb angle frames	8½ × 3½ × ·52	9 × 3½ × ·46	9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·44				
30	28	Frames	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·42	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·46			
		Reversed frames ..	5 × 3 × ·44	5½ × 3 × ·44	5½ × 3½ × ·42	5½ × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·46			
		Depth of framing ..	7½	8	8½	8½	9	9½			
		Bulb angle frames	9 × 3½ × ·42	9 × 3½ × ·50	9½ × 3½ × ·52	10 × 3½ × ·50	10½ × 3½ × ·48	10½ × 3½ × ·54			
31	28½	Frames	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·44	6½ × 3½ × ·44	6½ × 3½ × ·46	6½ × 3½ × ·46	7 × 3½ × ·46		
		Reversed frames ..	5½ × 3 × ·44	5½ × 3½ × ·44	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·46		
		Depth of framing ..	8	8	8½	9	9½	10	10½		
		Bulb angle frames	9 × 3½ × ·50	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·48		
32	29	Frames	5½ × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·48	
		Reversed frames ..	5½ × 3 × ·46	5½ × 3½ × ·46	5½ × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·48	6½ × 3½ × ·48	6½ × 3½ × ·48	7 × 3½ × ·48	
		Depth of framing ..	8	8	8½	9	9½	10	10½	11	
		Bulb angle frames	9½ × 3½ × ·44	9½ × 3½ × ·52	10 × 3½ × ·50	10½ × 3½ × ·46	11 × 3½ × ·46	11 × 3½ × ·56	11½ × 3½ × ·50	12 × 3½ × ·48	

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	5 × 3 × ·34	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·42	5 × 3½ × ·42	5½ × 3½ × ·40
		Reversed frames ..	3 × 3 × ·34	4½ × 3 × ·38	4½ × 3 × ·40	4½ × 3 × ·42	5 × 3 × ·42	5 × 3 × ·40
		Depth of framing ..	5½	6½	6½	6½	7	7½
		Bulb angle frames ..	7 × 3 × ·36	8 × 3½ × ·38	8 × 3½ × ·40	8 × 3½ × ·44	8½ × 3½ × ·42	8½ × 3½ × ·48
34	30	Frames	5 × 3 × ·36	5 × 3½ × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5 × 3½ × ·44	5½ × 3½ × ·42
		Reversed frames ..	3 × 3 × ·36	5 × 3 × ·38	5 × 3 × ·38	5 × 3 × ·40	5 × 3 × ·44	5 × 3 × ·42
		Depth of framing ..	5½	7	7	7	7	7½
		Bulb angle frames ..	7 × 3 × ·40	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·52	8½ × 3½ × ·46	8½ × 3½ × ·52
35	30½	Frames	5 × 3 × ·38	5 × 3½ × ·38	5 × 3½ × ·40	5½ × 3½ × ·38	5½ × 3½ × ·38	5½ × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·38	5 × 3 × ·38	5 × 3 × ·40	5 × 3 × ·38	5½ × 3 × ·38	5½ × 3 × ·40
		Depth of framing ..	5½	7	7	7½	8	8
		Bulb angle frames ..	7 × 3 × ·44	8 × 3½ × ·46	8 × 3½ × ·52	8½ × 3½ × ·44	8½ × 3½ × ·52	9 × 3½ × ·42
36	31	Frames	5½ × 3½ × ·36	5 × 3½ × ·40	5½ × 3½ × ·38	5½ × 3½ × ·42	5½ × 3½ × ·40	5½ × 3½ × ·42
		Reversed frames ..	3 × 3 × ·36	5 × 3 × ·40	5 × 3 × ·38	5 × 3 × ·42	5½ × 3 × ·40	5½ × 3 × ·42
		Depth of framing ..	6	7	7½	7½	8	8
		Bulb angle frames ..	7½ × 3½ × ·36	8 × 3½ × ·52	8½ × 3½ × ·44	8½ × 3½ × ·52	9 × 3½ × ·42	9 × 3½ × ·46
37	31½	Frames	5½ × 3½ × ·38	5½ × 3½ × ·40	5½ × 3½ × ·42	5½ × 3½ × ·44	5½ × 3½ × ·42	5½ × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·38	5 × 3 × ·40	5 × 3 × ·42	5 × 3 × ·44	5½ × 3 × ·42	5½ × 3½ × ·40
		Depth of framing ..	6	7½	7½	7½	8	8
		Bulb angle frames ..	7½ × 3½ × ·40	8½ × 3½ × ·48	8½ × 3½ × ·52	9 × 3½ × ·42	9 × 3½ × ·46	9½ × 3½ × ·42
38	32	Frames	5½ × 3½ × ·40	5½ × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·40
		Reversed frames ..	3½ × 3 × ·40	5 × 3 × ·42	5 × 3 × ·40	5 × 3 × ·42	5 × 3½ × ·40	5½ × 3½ × ·40
		Depth of framing ..	6	7½	8	8	8	8½
		Bulb angle frames ..	7½ × 3½ × ·44	8½ × 3½ × ·52	9 × 3½ × ·42	9 × 3½ × ·46	9½ × 3½ × ·42	9½ × 3½ × ·48
39	32½	Frames	6 × 3½ × ·40	6 × 3½ × ·42	6 × 3½ × ·44	6 × 3½ × ·42	6 × 3½ × ·40	6 × 3½ × ·42
		Reversed frames ..	3½ × 3 × ·40	5 × 3 × ·42	5 × 3 × ·44	5½ × 3 × ·42	5½ × 3½ × ·40	5½ × 3½ × ·42
		Depth of framing ..	6½	8	8	8½	8½	8½
		Bulb angle frames ..	8 × 3½ × ·40	9 × 3½ × ·46	9½ × 3½ × ·40	9½ × 3½ × ·44	9½ × 3½ × ·48	10 × 3½ × ·42

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet. 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	5½ × 3½ × ·42	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·44	6 × 3½ × ·44	6½ × 3½ × ·46
		Reversed frames ..	5½ × 3 × ·42	5½ × 3 × ·44	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·44	6 × 3½ × ·46
		Depth of framing ..	8	8	8	8½	9	9½
		Bulb angle frames..	9 × 3½ × ·46	9 × 3½ × ·50	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·54
34	30	Frames	5½ × 3½ × ·44	5½ × 3½ × ·42	6 × 3½ × ·42	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·48
		Reversed frames ..	5½ × 3 × ·44	5½ × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·48
		Depth of framing ..	8	8	8½	8½	9	9½
		Bulb angle frames..	9 × 3½ × ·50	9½ × 3½ × ·46	9½ × 3½ × ·52	10 × 3½ × ·50	10½ × 3½ × ·46	11 × 3½ × ·46
35	30½	Frames	5½ × 3½ × ·40	6 × 3½ × ·40	6 × 3½ × ·44	6½ × 3½ × ·44	6½ × 3½ × ·44	6½ × 3½ × ·46
		Reversed frames ..	5½ × 3½ × ·40	5½ × 3½ × ·40	5½ × 3½ × ·44	5½ × 3½ × ·44	6 × 3½ × ·44	6½ × 3½ × ·46
		Depth of framing ..	8	8½	8½	9	9½	10
		Bulb angle frames..	9½ × 3½ × ·42	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·50	11 × 3½ × ·50
36	31	Frames	5½ × 3½ × ·42	6 × 3½ × ·42	6 × 3½ × ·46	6½ × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·48
		Reversed frames ..	5½ × 3½ × ·42	5½ × 3½ × ·42	5½ × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·48	6½ × 3½ × ·48
		Depth of framing ..	8	8½	8½	9	9½	10
		Bulb angle frames..	9½ × 3½ × ·46	10 × 3½ × ·42	10 × 3½ × ·50	10½ × 3½ × ·46	11 × 3½ × ·46	11 × 3½ × ·56
37	31½	Frames	6 × 3½ × ·40	6 × 3½ × ·44	6 × 3½ × ·44	6½ × 3½ × ·46	7 × 3½ × ·46	7 × 3½ × ·48
		Reversed frames ..	5½ × 3½ × ·40	5½ × 3½ × ·44	6 × 3½ × ·44	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·48
		Depth of framing ..	8½	8½	9	9½	10	10½
		Bulb angle frames..	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·50
38	32	Frames	6 × 3½ × ·42	6 × 3½ × ·44	6 × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·50
		Reversed frames ..	5½ × 3½ × ·42	6 × 3½ × ·44	6 × 3½ × ·46	6 × 3½ × ·48	6 × 3½ × ·48	6½ × 3½ × ·50
		Depth of framing ..	8½	9	9	9½	10	10½
		Bulb angle frames..	10 × 3½ × ·42	10 × 3½ × ·54	10½ × 3½ × ·46	11 × 3½ × ·46	11 × 3½ × ·56	11½ × 3½ × ·56
39	32½	Frames	6 × 3½ × ·42	6 × 3½ × ·46	6½ × 3½ × ·46	7 × 3½ × ·46	7 × 3½ × ·48	7½ × 3½ × ·48
		Reversed frames ..	6 × 3½ × ·42	6 × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·48
		Depth of framing ..	9	9	9½	10	10½	11
		Bulb angle frames..	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·50	12 × 3½ × ·48

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
33	29½	Frames	6½ × 3½ × ·46	7 × 3½ × ·48	7 × 3½ × ·48	7½ × 3½ × ·48		
		Reversed frames	6½ × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·48		
		Depth of framing	10	10½	11	11½		
		Bulb angle frames	11 × 3½ × ·50	11½ × 3½ × ·50	12 × 3½ × ·48	12 × 3½ × ·56		
34	30	Frames	6½ × 3½ × ·48	7 × 3½ × ·50	7 × 3½ × ·50	7½ × 3½ × ·50		
		Reversed frames	6½ × 3½ × ·48	6½ × 3½ × ·50	7 × 3½ × ·50	7 × 3½ × ·50		
		Depth of framing	10	10½	11	11½		
		Bulb angle frames	11 × 3½ × ·56	11½ × 3½ × ·56	12 × 3½ × ·52	12 × 3½ × ·62		
35	30½	Frames	7 × 3½ × ·46	7½ × 3½ × ·48	7½ × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	
		Reversed frames	6½ × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·48	7 × 3½ × ·48	7½ × 3½ × ·50	
		Depth of framing	10½	11	11½	12	12½	
		Bulb angle or channel frames	11½ × 3½ × ·48	12 × 3½ × ·48	12 × 3½ × ·56	12 × 3½ × ·66	12 × 3½ × 3½ × ·58	
36	31	Frames	7 × 3½ × ·50	7½ × 3½ × ·48	7½ × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·50	9 × 4 × ·52
		Reversed frames	6½ × 3½ × ·50	7 × 3½ × ·48	7 × 3½ × ·50	7½ × 3½ × ·52	7½ × 3½ × ·50	8 × 3½ × ·52
		Depth of framing	10½	11½	11½	12	13	13½
		Bulb angle or channel frames	11½ × 3½ × ·56	12 × 3½ × ·56	12 × 3½ × ·62	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·54	13 × 4 × 4 × ·52
37	31½	Frames	7½ × 3½ × ·48	7½ × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·50	9 × 4 × ·54
		Reversed frames	6½ × 3½ × ·48	7 × 3½ × ·50	7 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·50	8 × 3½ × ·54
		Depth of framing	11	11½	12	12½	13½	13½
		Bulb angle or channel frames	11½ × 3½ × ·60	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54
38	32	Frames	7½ × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52	8 × 3½ × ·54	9 × 4 × ·52	9 × 4 × ·54
		Reversed frames	6½ × 3½ × ·50	7½ × 3½ × ·52	7½ × 3½ × ·52	8 × 3½ × ·54	8 × 3½ × ·52	8½ × 3½ × ·54
		Depth of framing	11	11½	12	12½	13½	14
		Bulb angle or channel frames	12 × 3½ × ·52	12 × 3½ × ·66	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·56	13 × 4 × 4 × ·52	14 × 4 × 4 × ·50
39	32½	Frames	7½ × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	9 × 4 × ·50	9 × 4 × ·54	9 × 4 × ·56
		Reversed frames	7 × 3½ × ·50	7 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·50	8 × 3½ × ·54	8½ × 3½ × ·56
		Depth of framing	11½	12	12½	13½	13½	14
		Bulb angle or channel frames	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	13 × 4 × 4 × ·50	13 × 4 × 4 × ·54	14 × 4 × 4 × ·52

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	FRAMING IN PEAKS.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.				
				Feet. 8	Feet. 10	Feet. 12	Feet. 13	Feet. 14
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	6 × 3½ × ·42	6½ × 3½ × ·40	6½ × 3½ × ·42	6½ × 3½ × ·44	6½ × 3½ × ·42	6½ × 3½ × ·44
		Reversed frames ..	3½ × 3 × ·42	5 × 3 × ·40	5 × 3 × ·42	5 × 3 × ·44	5 × 3½ × ·42	5 × 3½ × ·44
		Depth of framing ..	6½	8½	8½	8½	8½	8½
		Bulb angle frames..	8 × 3½ × ·44	9 × 3½ × ·52	9½ × 3½ × ·44	9½ × 3½ × ·48	10 × 3½ × ·42	10 × 3½ × ·46
41	33½	Frames	6½ × 3½ × ·42	6½ × 3½ × ·44	6½ × 3½ × ·46	6½ × 3½ × ·48	6½ × 3½ × ·44	6½ × 3½ × ·46
		Reversed frames ..	3½ × 3 × ·42	5 × 3 × ·44	5 × 3 × ·46	5 × 3 × ·48	5 × 3½ × ·44	5 × 3½ × ·46
		Depth of framing ..	7	8½	8½	8½	8½	8½
		Bulb angle frames..	8½ × 3½ × ·42	9½ × 3½ × ·48	9½ × 3½ × ·50	10 × 3½ × ·44	10 × 3½ × ·46	10 × 3½ × ·50
42	34	Frames	7 × 3½ × ·42	7 × 3½ × ·42	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·48	7 × 3½ × ·46
		Reversed frames ..	3½ × 3 × ·42	4½ × 3½ × ·42	4½ × 3½ × ·44	4½ × 3½ × ·46	4½ × 3½ × ·48	5 × 3½ × ·46
		Depth of framing ..	7½	8½	8½	8½	8½	9
		Bulb angle frames..	8½ × 3½ × ·52	9½ × 3½ × ·52	10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·46
43	34½	Frames	7½ × 3½ × ·42	7½ × 3½ × ·44	7½ × 3½ × ·42	7½ × 3½ × ·44	7½ × 3½ × ·46	7½ × 3½ × ·44
		Reversed frames ..	3½ × 3 × ·42	4 × 3½ × ·44	4½ × 3½ × ·42	4½ × 3½ × ·44	4½ × 3½ × ·46	5 × 3½ × ·44
		Depth of framing ..	8	8½	9	9	9	9½
		Bulb angle frames..	9 × 3½ × ·46	10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·46	10½ × 3½ × ·50
44	35	Frames	7½ × 3½ × ·42	7½ × 3½ × ·44	7½ × 3½ × ·46	7½ × 3½ × ·48	7½ × 3½ × ·46	8 × 3½ × ·44
		Reversed frames ..	3½ × 3½ × ·42	4½ × 3½ × ·44	4½ × 3½ × ·46	4½ × 3½ × ·48	5 × 3½ × ·46	5 × 3½ × ·44
		Depth of framing ..	8	9	9	9	9½	10
		Bulb angle frames..	9½ × 3½ × ·46	10 × 3½ × ·54	10½ × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·54	10½ × 3½ × ·58
45	35½	Frames	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46
		Reversed frames ..	3½ × 3½ × ·42	4 × 3½ × ·46	4½ × 3½ × ·44	4½ × 3½ × ·46	5 × 3½ × ·44	5 × 3½ × ·46
		Depth of framing..	8½	9	9½	9½	10	10
		Bulb angle frames..	9½ × 3½ × ·52	10½ × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·54	10½ × 3½ × ·58	11 × 3½ × ·50
46	36	Frames	8 × 3½ × ·42	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·44	8 × 3½ × ·46
		Reversed frames ..	4 × 3½ × ·42	4½ × 3½ × ·46	5 × 3½ × ·44	5 × 3½ × ·46	5½ × 3½ × ·44	5½ × 3½ × ·46
		Depth of framing ..	9	9½	10	10	10½	10½
		Bulb angle frames..	10 × 3½ × ·50	10½ × 3½ × ·54	10½ × 3½ × ·58	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·48

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4

(See Continuation.)

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 15	Feet. 16	Feet. 17	Feet. 18	Feet. 19	Feet 20
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	6½ × 3½ × ·44	6½ × 3½ × ·44	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·50	7½ × 3½ × ·52
		Reversed frames ..	5½ × 3½ × ·44	6 × 3½ × ·44	6 × 3½ × ·44	6½ × 3½ × ·46	6½ × 3½ × ·50	7 × 3½ × ·52
		Depth of framing ..	9	9½	10	10½	10½	11
		Bulb angle frames..	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·58	11½ × 3½ × ·48	11½ × 3½ × ·56	12 × 3½ × ·56
41	33½	Frames	6½ × 3½ × ·46	6½ × 3½ × ·46	7 × 3½ × ·46	7 × 3½ × ·48	7 × 3½ × ·54	7½ × 3½ × ·54
		Reversed frames ..	5½ × 3½ × ·46	6 × 3½ × ·46	6 × 3½ × ·46	6½ × 3½ × ·48	7 × 3½ × ·54	7 × 3½ × ·54
		Depth of framing ..	9	9½	10	10½	10½	11
		Bulb angle frames..	10½ × 3½ × ·46	10½ × 3½ × ·54	11 × 3½ × ·50	11½ × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·62
42	34	Frames	7 × 3½ × ·48	7 × 3½ × ·44	7 × 3½ × ·46	7 × 3½ × ·50	7½ × 3½ × ·52	8 × 3½ × ·52
		Reversed frames ..	5 × 3½ × ·48	6 × 3½ × ·44	6½ × 3½ × ·46	6½ × 3½ × ·50	7 × 3½ × ·52	7 × 3½ × ·52
		Depth of framing ..	9	10	10½	10½	11	11½
		Bulb angle frames..	10½ × 3½ × ·50	10½ × 3½ × ·58	11½ × 3½ × ·48	11½ × 3½ × ·56	12 × 3½ × ·56	12 × 3½ × ·66
43	34½	Frames	7½ × 3½ × ·48	7½ × 3½ × ·48	8 × 3½ × ·48	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52
		Reversed frames ..	5 × 3½ × ·48	5½ × 3½ × ·48	5½ × 3½ × ·48	6 × 3½ × ·50	6½ × 3½ × ·50	7½ × 3½ × ·52
		Depth of framing ..	9½	10	10½	11	11½	12
		Bulb angle or channel frames	11 × 3½ × ·46	11 × 3½ × ·56	11½ × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × 3½ × ·56
44	35	Frames	8 × 3½ × ·46	8 × 3½ × ·46	8 × 3½ × ·48	8 × 3½ × ·52	8 × 3½ × ·54	8 × 3½ × ·54
		Reversed frames ..	5 × 3½ × ·46	5½ × 3½ × ·46	6 × 3½ × ·48	6½ × 3½ × ·52	7 × 3½ × ·54	7½ × 3½ × ·54
		Depth of framing ..	10	10½	11	11	11½	12
		Bulb angle or channel frames	11 × 3½ × ·50	11½ × 3½ × ·48	12 × 3½ × ·48	12 × 3½ × ·56	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·58
45	35½	Frames	8 × 3½ × ·46	8 × 3½ × ·50	8 × 3½ × ·50	8 × 3½ × ·52	8½ × 3½ × ·52	8½ × 3½ × ·54
		Reversed frames ..	5½ × 3½ × ·46	5½ × 3½ × ·50	6 × 3½ × ·50	7 × 3½ × ·52	7 × 3½ × ·52	7½ × 3½ × ·54
		Depth of framing ..	10½	10½	11	11½	12	12½
		Bulb angle or channel frames	11½ × 3½ × ·48	11½ × 3½ × ·56	12 × 3½ × ·52	12 × 3½ × ·66	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·56
46	36	Frames	8 × 3½ × ·46	8 × 3½ × ·50	8 × 3½ × ·50	8½ × 3½ × ·50	8½ × 3½ × ·52	9 × 4 × ·52
		Reversed frames ..	6 × 3½ × ·46	6 × 3½ × ·50	6½ × 3½ × ·50	6½ × 3½ × ·50	7½ × 3½ × ·52	7½ × 3½ × ·52
		Depth of framing ..	11	11	11½	12	12½	13
		Bulb angle or channel frames	11½ × 3½ × ·54	12 × 3½ × ·52	12 × 3½ × ·62	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	12 × 4 × 4 × ·58

SIDE FRAMING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 4 *(Concluded.)*

D	FRAME SPACING.	TYPE OF FRAMING.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO LOWEST DECK AT SIDE.					
			Feet. 21	Feet. 22	Feet. 23	Feet. 24	Feet. 25	Feet. 26
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
40	33	Frames	8 ×3½×·52	8 ×3½×·54	8 ×3½×·54	9 ×4 ×·52	9 ×4 ×·54	9 ×4 ×·58
		Reversed frames	7 ×3½×·52	7½×3½×·54	8 ×3½×·54	8 ×3½×·52	8½×3½×·54	8½×3½×·58
		Depth of framing	11½	12	12½	13½	14	14
		Bulb angle or channel frames	12 ×3½×·66	12×3½×3½×·58	12×4 ×4 ×·56	13×4 ×4 ×·52	14×4 ×4 ×·50	14×4 ×4 ×·56
41	33½	Frames	8 ×3½×·52	8½×3½×·52	8½×3½×·54	9 ×4 ×·54	9 ×4 ×·56	9½×4 ×·52
		Reversed frames	7½×3½×·52	7½×3½×·52	8 ×3½×·54	8 ×3½×·54	8½×3½×·56	8½×4 ×·52
		Depth of framing	12	12½	13	13½	14	14½
		Channel frames	12×3½×3½×·56	12×4 ×4 ×·52	13×4 ×4 ×·50	13×4 ×4 ×·54	14×4 ×4 ×·52	14×4 ×4 ×·58
42	34	Frames	8½×3½×·50	8½×3½×·52	9 ×4 ×·52	9 ×4 ×·54	9 ×4 ×·58	9½×4 ×·56
		Reversed frames	7 ×3½×·50	8 ×3½×·52	8 ×3½×·52	8½×3½×·54	8½×3½×·58	8½×4 ×·56
		Depth of framing	12½	13	13½	14	14	14½
		Channel frames	12×3½×3½×·58	12×4 ×4 ×·58	13×4 ×4 ×·52	14×4 ×4 ×·50	14×4 ×4 ×·56	15×4 ×4 ×·54
43	34½	Frames	8½×3½×·50	8½×3½×·54	9 ×4 ×·52	9 ×4 ×·56	9½×4 ×·54	9½×4 ×·58
		Reversed frames	7½×3½×·50	8 ×3½×·54	8½×3½×·52	8½×3½×·56	8½×4 ×·54	8½×4 ×·58
		Depth of framing	12½	13	14	14	14½	14½
		Channel frames	12×4 ×4 ×·50	13×4 ×4 ×·50	13×4 ×4 ×·58	14×4 ×4 ×·52	15×4 ×4 ×·52	15×4 ×4 ×·56
44	35	Frames	8½×3½×·52	8½×3½×·54	9 ×4 ×·54	9½×4 ×·52	9½×4 ×·56	9½×4 ×·60
		Reversed frames	8 ×3½×·52	8½×3½×·54	8½×3½×·54	8½×4 ×·52	8½×4 ×·56	8½×4 ×·60
		Depth of framing	13	13½	14	14½	14½	14½
		Channel frames	12×4 ×4 ×·58	13×4 ×4 ×·54	14×4 ×4 ×·50	14×4 ×4 ×·58	15×4 ×4 ×·54	15×4 ×4 ×·58
45	35½	Frames	8½×3½×·54	8½×3½×·56	9 ×4 ×·58	9½×4 ×·54	9½×4 ×·60	
		Reversed frames	8 ×3½×·54	8½×3½×·56	8½×3½×·58	8½×4 ×·54	8½×4 ×·60	
		Depth of framing	13	13½	14	14½	14½	
		Channel frames	13×4 ×4 ×·50	13×4 ×4 ×·58	14×4 ×4 ×·56	15×4 ×4 ×·52	15×4 ×4 ×·58	
46	36	Frames	9 ×4 ×·54	9 ×4 ×·54	9½×4 ×·52	9½×4 ×·56	9½×4 ×·62	
		Reversed frames	8 ×3½×·54	8½×3½×·54	8½×4 ×·52	8½×4 ×·56	8½×4 ×·62	
		Depth of framing	13½	14	14½	14½	14½	
		Channel frames	13×4 ×4 ×·54	14×4 ×4 ×·50	14×4 ×4 ×·58	15×4 ×4 ×·54	15×4 ×4 ×·62	

PANTING ARRANGEMENTS.

DEEP FRAMES and INTERCOSTAL STRINGERS.

TABLE 5

(See Continuation.)

DEPTH D			DEPTH (d) AT COLLISION BULKHEAD FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO TOP OF BEAMS AT SIDE OF LOWEST DECK.						
Full Scantling Vessels.	Complete Superstructure Vessels.		Feet. 10	Feet. 12	Feet. 14	Feet. 16	Feet. 18	Feet. 20	Feet. 22
Feet.	Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	18	BULB ANGLES	5 ×3 ×·28	5 ×3 ×·34	5½×3 ×·36	6 ×3 ×·34	6½×3 ×·34	7 ×3 ×·32	
12	20		5 ×3 ×·34	5½×3 ×·34	6 ×3 ×·32	6½×3 ×·34	7 ×3 ×·36	7½×3 ×·34	8 ×3 ×·36
14	21		5½×3 ×·34	6 ×3 ×·32	6½×3 ×·32	7 ×3 ×·34	7½×3 ×·36	8 ×3 ×·36	8½×3 ×·38
16	22		6 ×3 ×·36	6½×3 ×·36	7 ×3 ×·34	7½×3 ×·34	8 ×3 ×·36	8½×3 ×·36	9 ×3 ×·40
18	23		6½×3 ×·38	7 ×3 ×·38	7½×3 ×·34	8 ×3 ×·36	8½×3 ×·36	9 ×3 ×·40	9½×3½×·40
20	24		7 ×3 ×·38	7½×3 ×·38	8 ×3 ×·36	8½×3 ×·36	9 ×3 ×·40	9 ×3 ×·46	9½×3½×·46
22	26		7½×3 ×·40	8 ×3 ×·40	8½×3 ×·38	9 ×3 ×·40	9 ×3 ×·46	9½×3½×·42	10 ×3½×·46
24	28		8 ×3 ×·40	8½×3 ×·40	9 ×3 ×·40	9 ×3 ×·46	9½×3½×·42	10 ×3½×·44	10½×3½×·46
26	30		8½×3 ×·40	9 ×3 ×·40	9½×3½×·40	9½×3½×·46	10 ×3½×·44	10½×3½×·42	11 ×3½×·46
28	32		9 ×3 ×·42	9½×3½×·42	10 ×3½×·42	10 ×3½×·46	10½×3½×·42	11 ×3½×·44	11½×3½×·46
30	34		9½×3½×·42	10 ×3½×·42	10 ×3½×·50	10½×3½×·46	11 ×3½×·44	11½×3½×·44	12 ×3½×·48
32	36		10 ×3½×·44	10½×3½×·44	10½×3½×·50	11 ×3½×·48	11½×3½×·46	12 ×3½×·46	12×3½×3½×·46
34	38		10½×3½×·46	11 ×3½×·46	11 ×3½×·52	11½×3½×·50	12 ×3½×·48	12×3½×3½×·44	12×4 ×4 ×·46
36	40		11 ×3½×·46	11½×3½×·46	12 ×3½×·46	12 ×3½×·52	12×3½×3½×·46	12×4 ×4 ×·44	13×4 ×4 ×·44
38	42		11½×3½×·48	12 ×3½×·50	12×3½×3½×·44	12×3½×3½×·48	12×4 ×4 ×·48	13×4 ×4 ×·44	14×4 ×4 ×·44
40	44	V	12 ×3½×·50	12×4×4×·42	12×4 ×4 ×·46	13×4 ×4 ×·42	13×4 ×4 ×·46	14×4 ×4 ×·44	14×4 ×4 ×·50
42	46	^	12×4 ×4 ×·42	13×4×4×·42	13×4 ×4 ×·46	14×4 ×4 ×·42	14×4 ×4 ×·46	14×4 ×4 ×·52	15×4 ×4 ×·50
44		CHANNELS	13×4 ×4 ×·42	14×4×4×·44	14×4 ×4 ×·48	15×4 ×4 ×·42	15×4 ×4 ×·46	15×4 ×4 ×·52	15×4 ×4 ×·60
46		V	14×4 ×4 ×·44	15×4×4×·46	15×4 ×4 ×·50	15×4 ×4 ×·54	15×4 ×4 ×·58	13×4 ×4 ×·48 4 ×4 ×·48	13×4 ×4 ×·54 4 ×4 ×·54

PANTING ARRANGEMENTS.

DEEP FRAMES and INTERCOSTAL STRINGERS.

TABLE 5 *(Concluded.)*

DEPTH D			DEPTH (d) AT COLLISION BULKHEAD FROM TOP OF FLOORS AT CENTRE IN WAY OF SINGLE BOTTOMS, AND FROM TOP OF MARGIN PLATE IN WAY OF DOUBLE BOTTOMS, TO TOP OF BEAMS AT SIDE OF LOWEST DECK.						Thickness of Stringer Plate.	Face Angle on Stringer.
Full Scantling Vessels.	Complete Superstructure Vessels.		Feet. 24	Feet. 26	Feet. 28	Feet. 30	Feet. 32	Feet. 34		
Feet.	Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12	20	BULB ANGLES							·30	3 ×3 ×·30
14	21								·30	3 ×3 ×·34
16	22		$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$						·32	$3\frac{1}{2}\times3\times\cdot34$
18	23		10 ×$3\frac{1}{2}$×·46	11 ×$3\frac{1}{2}$×·50					·34	4 ×3 ×·34
20	24		$10\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$11\frac{1}{2}\times3\frac{1}{2}\times\cdot48$	12×4 ×4 ×·44				·34	4 ×3 ×·38
22	26		11 ×$3\frac{1}{2}$×·46	12 ×$3\frac{1}{2}$×·48	12×4 ×4 ×·50	14×4 ×4 ×·46			·36	$4\frac{1}{2}\times3\times\cdot40$
24	28		$11\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	13×4 ×4 ×·44	15×4 ×4 ×·44	15×4 ×4 ×·58		·38	5 ×3 ×·40
26	30		12 ×$3\frac{1}{2}$×·48	12×4 ×4 ×·44	13×4 ×4 ×·50	15×4 ×4 ×·48	15×4 ×4 ×·64	13×4 ×4 ×·52 4 ×4 ×·52	·40	$5\frac{1}{2}\times3\times\cdot40$
28	32	CHANNELS	12×$3\frac{1}{2}$×$3\frac{1}{2}$×·42	13×4 ×4 ×·42	14×4 ×4 ×·46	15×4 ×4 ×·52	13×4 ×4 ×·48 4 ×4 ×·48	14×4 ×4 ×·48 4 ×4 ×·48	·40	$5\frac{1}{2}\times3\frac{1}{2}\times\cdot42$
30	34		12×4 ×4 ×·42	13×4 ×4 ×·48	14×4 ×4 ×·52	15×4 ×4 ×·56	13×4 ×4 ×·54 4 ×4 ×·54	14×4 ×4 ×·52 4 ×4 ×·52	·42	6 ×$3\frac{1}{2}$×·42
32	36		13×4 ×4 ×·42	14×4 ×4 ×·44	15×4 ×4 ×·48	15×4 ×4 ×·62	14×4 ×4 ×·48 4 ×4 ×·48	14×4 ×4 ×·56 4 ×4 ×·56	·44	6 ×$3\frac{1}{2}$×·46
34	38		13×4 ×4 ×·48	15×4 ×4 ×·42	15×4 ×4 ×·56	13×4 ×4 ×·50 4 ×4 ×·50	14×4 ×4 ×·52 4 ×4 ×·52	15×4 ×4 ×·50 4 ×4 ×·50	·44	$6\frac{1}{2}\times3\frac{1}{2}\times\cdot46$
36	40		14×4 ×4 ×·44	15×4 ×4 ×·48	15×4 ×4 ×·64	13×4 ×4 ×·56 4 ×4 ×·56	14×4 ×4 ×·56 4 ×4 ×·56	15×4 ×4 ×·56 4 ×4 ×·56	·46	7 ×$3\frac{1}{2}$×·48
38	42		14×4 ×4 ×·52	15×4 ×4 ×·56	13×4 ×4 ×·50 4 ×4 ×·50	14×4 ×4 ×·50 4 ×4 ×·50	15×4 ×4 ×·50 4 ×4 ×·50	15×4 ×4 ×·62 4 ×4 ×·62	·48	$7\frac{1}{2}\times3\frac{1}{2}\times\cdot48$
40	44		15×4 ×4 ×·50	15×4 ×4 ×·64	13×4 ×4 ×·56 4 ×4 ×·56	14×4 ×4 ×·56 4 ×4 ×·56	15×4 ×4 ×·56 4 ×4 ×·56		·48	8 ×$3\frac{1}{2}$×·48
42	46		15×4 ×4 ×·58	13×4 ×4 ×·52 4 ×4 ×·52	14×4 ×4 ×·50 4 ×4 ×·50	15×4 ×4 ×·50 4 ×4 ×·50			·50	8 ×$3\frac{1}{2}$×·52
44		CHANNEL WITH REVERSE	13×4 ×4 ×·48 4 ×4 ×·48	14×4 ×4 ×·50 4 ×4 ×·50	14×4 ×4 ×·58 4 ×4 ×·58				·50	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot54$
46			14×4 ×4 ×·48 4 ×4 ×·48	14×4 ×4 ×·56 4 ×4 ×·56					·52	9 ×4 ×·54

DOUBLE BOTTOMS.

TABLE 6
(See Continuation.)

FIRST LONGITUDINAL NUMERAL. L × D	CENTRE GIRDER.					MARGIN PLATE.		FLOOR PLATES, SIDE GIRDERS AND BRACKETS INSIDE TANK.			INNER BOTTOM PLATING.					
	Height Above Base Line.		Thickness.			Thickness.		Thickness			Middle Line Strake, except in Boiler Room.	Thickness.		Thickness.		
	Full Scantling Vessels.	Complete Superstructure Vessels.	Half Length Amids.	At Ends.	In Boiler Room.	In Holds and Engine Room.	In Boiler Room.	Floors in Holds and Engine Room. Side Girders in Engine Room.	Floors and Side Girders in Boiler Room.	Side Girders in Holds.	Breadth.	Half Length Amids.	At Ends.	In Holds. Half Length Amids.	In Holds. At Ends.	In Engine Room.	In Boiler Room, including Middle Line Strake.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1250	27		·32	·26	·42	·28	·38	·26	·36	·26	37	·28	·26	·26	·26	·30	·42
1650	28		·34	·28	·44	·30	·40	·26	·36	·26	38	·30	·28	·28	·28	·32	·44
2100	29		·36	·30	·46	·30	·40	·28	·38	·28	39	·32	·30	·28	·28	·32	·44
2600	30		·38	·32	·48	·32	·42	·28	·38	·28	40	·34	·30	·30	·28	·34	·46
3150	31	29	·38	·34	·48	·34	·44	·30	·40	·28	41	·34	·32	·30	·30	·34	·46
3800	32	30	·40	·34	·50	·36	·46	·30	·40	·28	42	·36	·32	·32	·30	·36	·46
4500	33	31	·40	·36	·50	·36	·46	·32	·42	·30	43	·38	·34	·32	·30	·38	·48
5250	34	32	·42	·36	·52	·38	·48	·32	·42	·30	44	·38	·34	·34	·32	·38	·48
6050	35	33	·42	·36	·52	·40	·50	·34	·44	·32	45	·40	·34	·34	·32	·40	·50
6800	36	34	·44	·38	·54	·40	·50	·34	·44	·32	46	·42	·36	·36	·34	·42	·52
7550	37	35	·46	·38	·56	·42	·52	·34	·44	·32	47	·42	·36	·36	·34	·42	·52
8350	38	36	·46	·38	·56	·42	·52	·36	·46	·34	47	·44	·38	·38	·34	·44	·52
9150	39	37	·48	·40	·58	·44	·54	·36	·46	·34	48	·46	·38	·40	·34	·46	·54
10000	40	38	·48	·40	·58	·46	·56	·36	·46	·34	49	·48	·40	·40	·36	·48	·54
10900	41	39	·50	·40	·60	·48	·58	·38	·48	·36	49	·48	·40	·40	·36	·48	·56
11800	42	40	·50	·42	·60	·50	·58	·38	·48	·36	50	·50	·40	·42	·36	·50	·56
12750	43	41	·52	·44	·60	·50	·58	·40	·50	·36	51	·50	·42	·42	·38	·50	·56
13750	44	42	·52	·44	·60	·52	·58	·40	·50	·36	52	·50	·42	·42	·38	·50	·56
14850	45	43	·54	·46	·62	·54	·60	·42	·52	·38	53	·52	·44	·44	·40	·52	·58
15900	46	44	·54	·46	·62	·54	·60	·42	·52	·38	54	·52	·44	·44	·40	·52	·58
17000	47	45	·56	·48	·64	·56	·60	·44	·54	·40	55	·54	·46	·46	·42	·54	·60
18200	48	46	·56	·48	·64	·56	·60	·44	·54	·40	56	·56	·46	·48	·42	·56	·62
19500	49	47	·58	·50	·64	·58	·62	·46	·54	·42	57	·58	·48	·50	·44	·58	·62
20900	50	48	·58	·50	·64	·60	·64	·46	·54	·42	58	·58	·50	·50	·46	·58	·62
22400	51	49	·60	·52	·66	·62	·66	·48	·56	·44	60	·60	·52	·52	·48	·60	·64
24000	52	50	·62	·54	·68	·64	·68	·48	·56	·44	62	·62	·52	·54	·48	·62	·66
25700	53	51	·62	·54	·68	·66	·70	·50	·56	·46	64	·64	·54	·54	·50	·64	·66
27500		52	·64	·56	·68	·68	·72	·50	·56	·46	65	·66	·56	·56	·52	·64	·66
29400		53	·66	·58	·70	·68	·72	·50	·56	·46	67	·68	·58	·56	·52	·66	·68
31400		54	·68	·60	·72	·70	·74	·52	·56	·48	69	·70	·60	·58	·54	·66	·70
33600		55	·70	·62	·74	·70	·74	·52	·56	·48	70	·70	·60	·58	·54	·66	·70

DOUBLE BOTTOMS.

TABLE 6
(Concluded.)

FIRST LONGITUDINAL NUMERAL. L × D	DIMENSIONS OF ANGLE BARS.						
	Angles Connecting Centre Girder to Flat Plate Keel.		Angles Connecting Centre Girder to Inner Bottom.		Angles Connecting Margin Plate to Shell Plating.	Frames and Reversed* Frames on Floors, Side Girder Angles, Vertical Angles on Centre Girder and Margin Plate.	Vertical Angles Connecting Floors and Side Girders.
	Half Length Amidships.	Thickness at Ends.	Half Length Amidships.	Thickness at Ends.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1250	3 × 3 × ·32	·32	2½ × 2½ × ·28	·28	3 × 3 × ·30	2½ × 2½ × ·26	2½ × 2½ × ·26
1650	3 × 3 × ·34	·34	2½ × 2½ × ·30	·30	3 × 3 × ·32	2½ × 2½ × ·26	2½ × 2½ × ·26
2100	3 × 3 × ·36	·36	3 × 3 × ·32	·32	3 × 3 × ·32	3 × 3 × ·28	2½ × 2½ × ·28
2600	3 × 3 × ·38	·36	3 × 3 × ·34	·34	3 × 3 × ·34	3 × 3 × ·28	2½ × 2½ × ·28
3150	3 × 3 × ·38	·36	3 × 3 × ·34	·34	3 × 3 × ·36	3 × 3 × ·30	2½ × 2½ × ·28
3800	3½ × 3½ × ·40	·38	3 × 3 × ·36	·34	3 × 3 × ·38	3 × 3 × ·30	2½ × 2½ × ·30
4500	3½ × 3½ × ·40	·38	3 × 3 × ·36	·34	3 × 3 × ·40	3 × 3 × ·32	2½ × 2½ × ·30
5250	3½ × 3½ × ·42	·40	3 × 3 × ·38	·36	3 × 3 × ·40	3 × 3 × ·32	2½ × 2½ × ·30
6050	3½ × 3½ × ·42	·40	3 × 3 × ·38	·36	3 × 3 × ·42	3 × 3 × ·34	2½ × 2½ × ·32
6800	3½ × 3½ × ·44	·42	3 × 3 × ·38	·36	3 × 3 × ·42	3 × 3 × ·34	2½ × 2½ × ·32
7550	3½ × 3½ × ·44	·42	3 × 3 × ·40	·38	3½ × 3½ × ·44	3½ × 3½ × ·34	2½ × 2½ × ·32
8350	3½ × 3½ × ·46	·44	3 × 3 × ·40	·38	3½ × 3½ × ·44	3½ × 3½ × ·36	3 × 3 × ·34
9150	4 × 4 × ·46	·44	3 × 3 × ·42	·40	3½ × 3½ × ·46	3½ × 3½ × ·36	3 × 3 × ·34
10000	4 × 4 × ·48	·46	3 × 3 × ·42	·40	3½ × 3½ × ·48	3½ × 3½ × ·38	3 × 3 × ·34
10900	4 × 4 × ·48	·46	3 × 3 × ·44	·42	3½ × 3½ × ·48	3½ × 3½ × ·40	3 × 3 × ·36
11800	4 × 4 × ·50	·48	3½ × 3½ × ·44	·42	3½ × 3½ × ·50	3½ × 3½ × ·42	3 × 3 × ·36
12750	4 × 4 × ·50	·48	3½ × 3½ × ·46	·42	3½ × 3½ × ·50	3½ × 3½ × ·42	3 × 3 × ·38
13750	4 × 4 × ·52	·48	3½ × 3½ × ·46	·42	3½ × 3½ × ·52	3½ × 3½ × ·42	3 × 3 × ·38
14850	4 × 4 × ·54	·50	3½ × 3½ × ·48	·44	3½ × 3½ × ·54	3½ × 3½ × ·44	3 × 3 × ·40
15900	5 × 5 × ·54	·50	3½ × 3½ × ·48	·44	3½ × 3½ × ·54	3½ × 3½ × ·46	3 × 3 × ·40
17000	5 × 5 × ·56	·52	3½ × 3½ × ·50	·46	3½ × 3½ × ·56	3½ × 3½ × ·48	3 × 3 × ·42
18200	5 × 5 × ·56	·52	3½ × 3½ × ·50	·46	3½ × 3½ × ·56	3½ × 3½ × ·48	3 × 3 × ·42
19500	5 × 5 × ·58	·54	3½ × 3½ × ·52	·48	3½ × 3½ × ·58	3½ × 3½ × ·50	3 × 3 × ·44
20900	5 × 5 × ·60	·54	3½ × 3½ × ·54	·48	3½ × 3½ × ·60	3½ × 3½ × ·50	3 × 3 × ·44
22400	5 × 5 × ·60	·54	3½ × 3½ × ·56	·50	3½ × 3½ × ·62	3½ × 3½ × ·52	3 × 3 × ·46
24000	5 × 5 × ·62	·56	3½ × 3½ × ·58	·52	3½ × 3½ × ·64	3½ × 3½ × ·52	3 × 3 × ·46
25700	5 × 5 × ·62	·56	3½ × 3½ × ·60	·54	3½ × 3½ × ·66	3½ × 3½ × ·54	3 × 3 × ·48
27500	5 × 5 × ·64	·58	4 × 4 × ·62	·54	4 × 4 × ·68	4 × 4 × ·54	3 × 3 × ·48
29400	5 × 5 × ·66	·60	4 × 4 × ·64	·56	4 × 4 × ·70	4 × 4 × ·54	3 × 3 × ·48
31400	5 × 5 × ·68	·62	4 × 4 × ·66	·58	4 × 4 × ·72	4 × 4 × ·56	3 × 3 × ·50
33600	5 × 5 × ·70	·64	4 × 4 × ·68	·60	4 × 4 × ·74	4 × 4 × ·56	3 × 3 × ·50

In the boiler room the thicknesses of angle bars not covered by cement are to be increased by ·10 inch beyond those given in the Table.

*Flanges of reversed frames on floors and of top angles of intercostals need not exceed 3 inches where the thickness of the inner bottom plating does not exceed ·50 inch. The widths of the flanges of vertical connecting angles may be as required for the diameter of rivet used.

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BRACKET FLOORS in DOUBLE BOTTOMS. TABLE 7

FULL SCANTLING VESSELS.

DEPTH D.		UNSUPPORTED SPAN.					
		Feet 3	Feet. 4	Feet. 5	Feet. 6	Feet. 7	Feet. 8
Feet		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12	ANGLES	$3\frac{1}{2} \times 2\frac{1}{2} \times \cdot34$	$4 \times 2\frac{1}{2} \times \cdot34$	$4 \times 2\frac{1}{2} \times \cdot38$			
14	ANGLES	$4 \times 2\frac{1}{2} \times \cdot32$	$4 \times 2\frac{1}{2} \times \cdot36$	$4\frac{1}{2} \times 2\frac{1}{2} \times \cdot36$			
16	ANGLES	$4 \times 3 \times \cdot34$	$4\frac{1}{2} \times 3 \times \cdot34$	$5 \times 3 \times \cdot36$	$6 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot36$	$6 \times 3 \times \cdot34$
18	ANGLES	$4\frac{1}{2} \times 3 \times \cdot34$	$5 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot36$	$6\frac{1}{2} \times 3 \times \cdot34$	$6 \times 3 \times \cdot34$	$6\frac{1}{2} \times 3 \times \cdot34$
20	ANGLES	$5 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot34$	$6 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot34$	$6 \times 3 \times \cdot42$	$7 \times 3 \times \cdot34$
22	ANGLES	$5 \times 3\frac{1}{2} \times \cdot36$	$6 \times 3\frac{1}{2} \times \cdot34$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot32$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$7 \times 3\frac{1}{2} \times \cdot40$
24	ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$5 \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot36$	$7 \times 3\frac{1}{2} \times \cdot34$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$
26	ANGLES	$6 \times 3\frac{1}{2} \times \cdot36$	$5 \times 3\frac{1}{2} \times \cdot36$	$5 \times 3\frac{1}{2} \times \cdot46$	$6 \times 3\frac{1}{2} \times \cdot42$	$7 \times 3\frac{1}{2} \times \cdot40$	$8 \times 3\frac{1}{2} \times \cdot40$
28	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot36$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$8 \times 3\frac{1}{2} \times \cdot48$
30	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot38$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot38$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$
32	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot40$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$6 \times 3\frac{1}{2} \times \cdot44$	$7 \times 3\frac{1}{2} \times \cdot40$	$8 \times 3\frac{1}{2} \times \cdot40$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$
34	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot38$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$	$7 \times 3\frac{1}{2} \times \cdot48$	$8 \times 3\frac{1}{2} \times \cdot48$	$9 \times 3\frac{1}{2} \times \cdot48$
36	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$	$6 \times 3\frac{1}{2} \times \cdot44$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
38	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$7 \times 3\frac{1}{2} \times \cdot42$	$8 \times 3\frac{1}{2} \times \cdot40$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$	$10 \times 3\frac{1}{2} \times \cdot44$
40	BULB ANGLES	$6 \times 3\frac{1}{2} \times \cdot42$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$7 \times 3\frac{1}{2} \times \cdot48$	$8 \times 3\frac{1}{2} \times \cdot48$	$9 \times 3\frac{1}{2} \times \cdot50$	$10 \times 3\frac{1}{2} \times \cdot54$
42	BULB ANGLES	$6 \times 3\frac{1}{2} \times \cdot46$	$7 \times 3\frac{1}{2} \times \cdot42$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$
44	BULB ANGLES	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot56$	$11 \times 3\frac{1}{2} \times \cdot50$
46	BULB ANGLES	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$8 \times 3\frac{1}{2} \times \cdot48$	$9 \times 3\frac{1}{2} \times \cdot46$	$10 \times 3\frac{1}{2} \times \cdot54$	$11 \times 3\frac{1}{2} \times \cdot60$

COMPLETE SUPERSTRUCTURE VESSELS.

DEPTH D.		UNSUPPORTED SPAN.					
		Feet. 3	Feet. 4	Feet. 5	Feet. 6	Feet. 7	Feet. 8
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
16	ANGLES	$4 \times 3 \times \cdot34$	$4\frac{1}{2} \times 3 \times \cdot34$	$5 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot34$	$5 \times 3 \times \cdot32$	$5\frac{1}{2} \times 3 \times \cdot36$
18	ANGLES	$4 \times 3 \times \cdot34$	$4\frac{1}{2} \times 3 \times \cdot36$	$5 \times 3 \times \cdot38$	$6 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot32$	$6 \times 3 \times \cdot34$
20	ANGLES	$4 \times 3 \times \cdot36$	$5 \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot38$	$6\frac{1}{2} \times 3 \times \cdot34$	$5\frac{1}{2} \times 3 \times \cdot36$	$6 \times 3 \times \cdot40$
22	ANGLES	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$6 \times 3\frac{1}{2} \times \cdot34$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot34$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$
24	ANGLES	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$6 \times 3\frac{1}{2} \times \cdot38$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$6 \times 3\frac{1}{2} \times \cdot40$	$7 \times 3\frac{1}{2} \times \cdot36$
26	ANGLES	$5 \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot36$	$5 \times 3\frac{1}{2} \times \cdot36$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$7 \times 3\frac{1}{2} \times \cdot44$
28	ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot42$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$6 \times 3\frac{1}{2} \times \cdot34$	$7 \times 3\frac{1}{2} \times \cdot38$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$
30	ANGLES	$6 \times 3\frac{1}{2} \times \cdot36$	$5 \times 3\frac{1}{2} \times \cdot38$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$	$6 \times 3\frac{1}{2} \times \cdot40$	$7 \times 3\frac{1}{2} \times \cdot44$	$8 \times 3\frac{1}{2} \times \cdot40$
32	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot36$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$6 \times 3\frac{1}{2} \times \cdot36$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$8 \times 3\frac{1}{2} \times \cdot48$
34	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot38$	$6 \times 3\frac{1}{2} \times \cdot34$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot34$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
36	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot40$	$6 \times 3\frac{1}{2} \times \cdot36$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot38$	$7 \times 3\frac{1}{2} \times \cdot40$	$8 \times 3\frac{1}{2} \times \cdot44$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot54$
38	BULB ANGLES	$5 \times 3\frac{1}{2} \times \cdot44$	$6 \times 3\frac{1}{2} \times \cdot40$	$7 \times 3\frac{1}{2} \times \cdot36$	$7 \times 3\frac{1}{2} \times \cdot46$	$8 \times 3\frac{1}{2} \times \cdot50$	$9 \times 3\frac{1}{2} \times \cdot50$
40	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot36$	$7 \times 3\frac{1}{2} \times \cdot40$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
42	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot44$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot40$	$7 \times 3\frac{1}{2} \times \cdot46$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$8\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$	$10 \times 3\frac{1}{2} \times \cdot46$
44	BULB ANGLES	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot42$	$8 \times 3\frac{1}{2} \times \cdot44$	$9 \times 3\frac{1}{2} \times \cdot52$	$10 \times 3\frac{1}{2} \times \cdot54$
46	BULB ANGLES	$6 \times 3\frac{1}{2} \times \cdot44$	$7 \times 3\frac{1}{2} \times \cdot44$	$7\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$8 \times 3\frac{1}{2} \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$

The Frames are to have the scantlings given in the Tables. The Reversed Frames may be $\frac{1}{2}$-inch less in depth than given in the Tables, and the horizontal flanges may be 3 inches in breadth.

In the boiler room the thicknesses of bars not covered by cement are to be increased by ·10 inch beyond those given in the Tables.

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TABLE 7A

DETAILS of BRACKET FLOORS in DOUBLE BOTTOMS.

DEPTH OF FRAME.		RIVETS IN BRACKETS.		RIVETS IN EACH END OF VERTICAL BAR ON INTERCOSTAL GIRDER.		VERTICAL STRUTS BETWEEN INTERCOSTAL GIRDER AND CENTRE LINE OR MARGIN PLATE.	RIVETS IN EACH END OF VERTICAL STRUTS.	
		Number.	Diameter.	Number.	Diameter.	Channels.	Number.	Diameter.
Inches.			Inches.		Inches.	Inches.		Inches.
4 and $4\frac{1}{2}$	ANGLES	4	$\frac{5}{8}$	2	$\frac{5}{8}$	$6\times3\times3\times\cdot36$	2	$\frac{5}{8}$
5 „ $5\frac{1}{2}$	ANGLES	5	$\frac{5}{8}$	2	$\frac{5}{8}$	$7\times3\times3\times\cdot36$	3	$\frac{5}{8}$
6 „ $6\frac{1}{2}$	ANGLES	5	$\frac{3}{4}$	2	$\frac{3}{4}$	$8\times3\times3\times\cdot38$	4	$\frac{3}{4}$
5 „ $5\frac{1}{2}$	BULB ANGLES	5	$\frac{3}{4}$	2	$\frac{3}{4}$	$8\times3\times3\times\cdot38$	4	$\frac{3}{4}$
6 „ $6\frac{1}{2}$	BULB ANGLES	6	$\frac{3}{4}$	2	$\frac{3}{4}$	$8\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	4	$\frac{3}{4}$
7 „ $7\frac{1}{2}$	BULB ANGLES	7	$\frac{3}{4}$	3	$\frac{3}{4}$	$9\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	4	$\frac{3}{4}$
8 „ $8\frac{1}{2}$	BULB ANGLES	8	$\frac{3}{4}$	4	$\frac{3}{4}$	$9\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	5	$\frac{3}{4}$
9 „ $9\frac{1}{2}$	BULB ANGLES	8	$\frac{7}{8}$	4	$\frac{7}{8}$	$10\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	6	$\frac{7}{8}$
10 and above	BULB ANGLES	9	$\frac{7}{8}$	4	$\frac{7}{8}$	$10\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	6	$\frac{7}{8}$

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STIFFENING of WATERTIGHT FLOORS in DOUBLE BOTTOMS.

TABLE 7B

DEPTH OF CENTRE GIRDER.		HEIGHT OF OVERFLOW ABOVE INNER BOTTOM.						
		Feet. 20	Feet. 25	Feet. 30	Feet. 35	Feet. 40	Feet. 45	Feet. 50
Inches. 36	ANGLES	Inches. $3\frac{1}{2}\times3\times\cdot32$	Inches. $3\frac{1}{2}\times3\times\cdot40$	Inches. $4\times3\times\cdot36$	Inches. $4\frac{1}{2}\times3\times\cdot34$	Inches. $4\frac{1}{2}\times3\times\cdot38$	Inches. $5\times3\times\cdot36$	Inches. $5\times3\times\cdot40$
42	ANGLES	$4\times3\times\cdot34$	$4\times3\times\cdot42$	$4\frac{1}{2}\times3\times\cdot40$	$5\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot38$
48	ANGLES	$4\frac{1}{2}\times3\times\cdot38$	$5\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot36$	$6\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot36$
54	ANGLES	$5\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot38$	$6\times3\times\cdot34$	$6\times3\times\cdot40$
60	ANGLES	$5\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot34$	$6\times3\times\cdot40$	$6\frac{1}{2}\times3\times\cdot36$	$6\frac{1}{2}\times3\times\cdot44$
66	ANGLES	$6\times3\times\cdot42$	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot44$	$7\times3\times\cdot40$	$7\frac{1}{2}\times3\times\cdot36$
72	BULB ANGLES	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot36$	$7\times3\times\cdot36$	$7\times3\times\cdot44$	$7\frac{1}{2}\times3\times\cdot40$	$8\times3\times\cdot38$

LLOYD'S REGISTER OF SHIPPING, LONDON.—*16th April*, 1931.

DEPTHS of MARGIN PLATES of DOUBLE BOTTOMS and ATTACHMENT of TANK SIDE BRACKETS to MARGIN PLATES.

TABLE 8

(See Continuation.)

DEPTH D.		Height of Tank Side Brackets Above Base Line.	DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF MARGIN PLATE TO LOWEST DECK AT SIDE.													
			Feet. 10							Feet. 14						
					Attachment outside Margin Plate.							Attachment outside Margin Plate.				
						Gussets to Brackets.		Number and Diameter of Rivets in each Arm.					Gussets to Brackets.		Number and Diameter of Rivets in each Arm.	
Full Scantling Vessels.	Complete Super-structure Vessels.		Thickness of Tank Side Brackets outside Tank.	Depth of Margin Plate.	Angle Attachment.	Abaft ¼-Length from Stem.	Forward of ¼-Length from Stem.	Angle.	Gusset.	Thickness of Tank Side Brackets outside Tank.	Depth of Margin Plate.	Angle Attachment.	Abaft ¼-Length from Stem.	Forward of ¼-Length from Stem.	Angle.	Gusset.
Feet.	Feet.	Inches.	Inches.	Inches.				No. Ins.	No. Ins.	Inches.	Inches.				No. Ins.	No. Ins.
12	—	32	·28	19	Single	—	—	5 of ⅝	—	—	—	—	—	—	—	—
14	—	36	·30	20	,,	—	—	5 ,, ⅝	—	—	—	—	—	—	—	—
16	19	40	·32	21	,,	—	—	5 ,, ¾	—	—	—	—	—	—	—	—
18	21	44	·32	22	,,	—	—	5 ,, ¾	—	·34	23	Single	—	—	5 of ¾	—
20	23	48	·34	23	,,	—	—	5 ,, ¾	—	·34	24	,,	—	—	5 ,, ¾	—
22	25	52	·34	24	,,	—	—	5 ,, ¾	—	·36	25	,,	Every fifth frame	Every third frame	6 ,, ¾	4 of ¾
24	27	55	·34	25	,,	Every fifth frame	Every third frame	6 ,, ¾	5 of ¾	·36	26	,,	Every fourth frame	Every second frame	6 ,, ¾	5 ,, ¾
26	29	58	·36	27	,,	,,	,,	6 ,, ¾	6 ,, ¾	·38	28	,,	,,	,,	6 ,, ¾	6 ,, ¾
28	31	61	·36	29	,,	Every fourth frame	,,	6 ,, ⅞	6 ,, ⅞	·38	30	,,	Every third frame	Every frame	6 ,, ⅞	6 ,, ⅞
30	33	64	·38	31	,,	Every third frame	Every second frame	7 ,, ⅞	7 ,, ⅞	·38	32	,,	Every second frame	,,	7 ,, ⅞	6 ,, ⅞
32	35	67	·40	33	,,	,,	,,	7 ,, ⅞	8 ,, ⅞	·40	34	,,	,,	,,	7 ,, ⅞	7 ,, ⅞
34	37	70	·42	35	,,	Every second frame	,,	8 ,, ⅞	8 ,, ⅞	·42	36	,,	Every frame	,,	8 ,, ⅞	7 ,, ⅞
36	40	73	·44	37	,,	,,	Every frame	8 ,, ⅞	8 ,, ⅞	·44	38	,,	,,	,,	8 ,, ⅞	8 ,, ⅞
38	42	76	44	39	,,	Every frame	,,	8 ,, ⅞	8 ,, ⅞	·46	40	Double	,,	,,	7 ,, ⅞	5 ,, ⅞
40	44	79	·46	41	Double	,,	,,	7 ,, ⅞	5 ,, ⅞	·48	42	,,	,,	,,	8 ,, ⅞	5 ,, ⅞
42	46	82	·46	43	,,	,,	,,	8 ,, ⅞	5 ,, ⅞	·48	44	,,	,,	,,	8 ,, ⅞	6 ,, ⅞
44	48	85	·48	45	,,	,,	,,	8 ,, ⅞	6 ,, ⅞	—	—	—	—	—	—	—
46	50	88	·48	47	,,	,,	,,	8 ,, ⅞	7 ,, ⅞	—	—	—	—	—	—	—

DEPTHS of MARGIN PLATES of DOUBLE BOTTOMS and ATTACHMENT of TANK SIDE BRACKETS to MARGIN PLATES.

TABLE 8
(Concluded.)

DEPTH D.		DEPTH (d) AT MIDDLE OF LENGTH FROM TOP OF MARGIN PLATE TO LOWEST DECK AT SIDE.																				
		Feet. 18							Feet 22							Feet. 26						
				Attachment outside Margin Plate.							Attachment outside Margin Plate.							Attachment outside Margin Plate.						
Full Scantling Vessels.	Complete Superstructure Vessels.	Thickness of Tank Side Brackets outside Tank.	Depth of Margin Plate.	Angle Attachment.	Gussets to Brackets.		Number and Diameter of Rivets in each Arm.		Thickness of Tank Side Brackets outside Tank.	Depth of Margin Plate.	Angle Attachment.	Gussets to Brackets.		Number and Diameter of Rivets in each Arm.		Thickness of Tank Side Brackets outside Tank.	Depth of Margin Plate.	Angle Attachment.	Gussets to Brackets.		Number and Diameter of Rivets in each Arm.	
					Abaft ¼-Length from Stem.	Forward of ¼-Length from Stem.	Angle.	Gusset.				Abaft ¼-Length from Stem.	Forward of ¼-Length from Stem.	Angle.	Gusset.				Abaft ¼-Length from Stem.	Forward of ¼-Length from Stem.	Angle.	Gusset.
Feet.	Feet.	Inches	Inches				No. Ins.	No. Ins.	Inches	Inches				No. Ins.	No. Ins.	Inches	Inches				No. Ins.	No. Ins.
16	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	23	·36	25	Single	Every fourth frame	Every third frame	5 of ¾	4 of ¾	·36	26	Single	Every fourth frame	Every second frame	6 of ¾	6 of ¾	—	—	—	—	—	—	—
22	25	·36	26	„	Every third frame	Every second frame	6 „ ¾	5 „ ¾	·38	27	„	Every third frame	„	7 „ ¾	6 „ ¾	—	—	—	—	—	—	—
24	27	·36	27	„	„	„	6 „ ¾	6 „ ¾	·38	29	„	Every second frame	Every frame	7 „ ⅞	6 „ ⅞	—	—	—	—	—	—	—
26	29	·38	29	„	Every second frame	Every frame	6 „ ⅞	6 „ ⅞	·40	31	„	„	„	7 „ ⅞	7 „ ⅞	·40	33	Single	Every frame	Every frame	8 of ⅞	7 of ⅞
28	31	·38	31	„	„	„	7 „ ⅞	6 „ ⅞	·40	33	„	Every frame	„	8 „ ⅞	6 „ ⅞	·40	35	Double	„	„	6 „ ⅞	5 „ ⅞
30	33	·40	33	„	Every frame	„	8 „ ⅞	6 „ ⅞	·40	35	„	„	„	8 „ ⅞	7 „ ⅞	·42	37	„	„	„	7 „ ⅞	5 „ ⅞
32	35	·42	35	„	„	„	8 „ ⅞	7 „ ⅞	·42	37	„	„	„	8 „ ⅞	8 „ ⅞	·44	39	„	„	„	8 „ ⅞	6 „ ⅞
34	37	·44	37	„	„	„	8 „ ⅞	8 „ ⅞	·44	39	Double	„	„	7 „ ⅞	5 „ ⅞	·46	41	„	„	„	8 „ ⅞	6 „ ⅞
36	40	·46	39	Double	„	„	7 „ ⅞	5 „ ⅞	·46	41	„	„	„	8 „ ⅞	5 „ ⅞	·48	—	—	—	—	—	—
38	42	·48	41	„	„	„	8 „ ⅞	5 „ ⅞	·48	43	„	„	„	8 „ ⅞	6 „ ⅞	·50	—	—	—	—	—	—
40	44	·48	43	„	„	„	8 „ ⅞	6 „ ⅞	—	—	—	—	—	—	—	—	—	—	—	—	—	—
42	46																					
44	48																					
46	50																					

FLOOR PLATES in VESSELS having SINGLE BOTTOMS.

FULL SCANTLING VESSELS. TABLE 9

DEPTH D.	BREADTH B.								
	Feet. 16	Feet. 20	Feet. 24	Feet. 28	Feet. 32	Feet. 36	Feet. 40	Feet. 44	Feet. 48
Feet. 10	Inches. 10 × ·24	Inches. 11 × ·26	Inches. 12 × ·28	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12		12 × ·26	13 × ·28	14 × ·30					
14			14 × ·28	15 × ·30	17 × ·32				
16				17 × ·32	19 × ·34	21 × ·36			
18					20 × ·34	22 × ·38	24 × ·40		
20					21 × ·36	23 × ·38	25 × ·40	26 × ·42	
22						24 × ·40	26 × ·42	27 × ·44	29 × ·46
24						25 × ·40	27 × ·42	28 × ·44	30 × ·46

COMPLETE SUPERSTRUCTURE VESSELS.

DEPTH D.	BREADTH B.						
	Feet. 24	Feet. 28	Feet. 32	Feet. 36	Feet. 40	Feet. 44	Feet. 48
Feet. 16	Inches. 13 × ·28	Inches. 14 × ·28	Inches. 16 × ·32	Inches. 18 × ·34	Inches.	Inches.	Inches.
18	14 × ·28	15 × ·30	17 × ·32	19 × ·34	20 × ·34		
20			18 × ·34	20 × ·34	21 × ·36	22 × ·38	
22				21 × ·36	22 × ·38	24 × ·40	26 × ·42
24				22 × ·38	24 × ·40	25 × ·40	27 × ·42

In all vessels the thickness of the floors in the engine space is to be increased ·04 inch and in the boiler space ·10 inch beyond that given in the Tables.

LLOYD'S REGISTER OF SHIPPING, LONDON.—13*th July*, 1922.

KEELSONS in VESSELS with SINGLE BOTTOMS. TABLE 10

FIRST LONGITUDINAL NUMERAL. L × D	MIDDLE LINE KEELSONS.										SIDE KEELSONS.		
	With Bar Keel only.		With Bar Keel or Flat Plate Keel.						FLAT KEEL PLATE.				
	Standing upon Floors.		Standing upon Floors with Intercostal Plates.			Standing upon Floors with Centre Through Plate.							
	Double Bulb Angles.		Double Angles.		Thickness of Intercostal Plates.	Double Angles.	Thickness of Centre Through Plate and Foundation Plate.		Double Angles.		Double Angles.		Thickness of Intercostal Plates.
	For ½-Length Amids.	Thickness at Ends.	For ½-Length Amids.	Thickness at Ends.		Throughout.	For ½-Length Amids.	Thickness at Ends.	For ½-Length Amids.	Thickness at Ends.	For ½-Length Amids.	Thickness at Ends.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
600	5 × 3 × ·38	·38	3 × 3 × ·34	·26	·28	3 × 3 × ·26	·30	·26	3 × 3 × ·26	·26	3 × 3 × ·26	·24	·24
1100	5½ × 3 × ·40	·40	3½ × 3 × ·36	·28	·30	3½ × 3 × ·28	·32	·28	3½ × 3½ × ·30	·30	3½ × 3 × ·28	·26	·26
1650	6 × 3 × ·42	·42	4 × 3 × ·38	·28	·32	3½ × 3 × ·30	·34	·30	3½ × 3½ × ·36	·36	4 × 3 × ·30	·28	·28
2250	6½ × 3 × ·46	·44	4½ × 3 × ·40	·30	·34	4 × 3 × ·32	·38	·34	3½ × 3½ × ·40	·40	4½ × 3 × ·32	·28	·30
2900	7 × 3 × ·50	·46	4½ × 3½ × ·42	·32	·36	4 × 3½ × ·32	·40	·36	3½ × 3½ × ·44	·44	4½ × 3 × ·34	·30	·32
3650	7½ × 3½ × ·52	·48	5 × 3½ × ·44	·34	·38	4½ × 3½ × ·34	·42	·36	3½ × 3½ × ·48	·46	5 × 3 × ·36	·32	·34
4450	8 × 3½ × ·56	·50	5½ × 3½ × ·46	·36	·40	4½ × 3½ × ·36	·44	·38	4 × 4 × ·50	·46	5½ × 3½ × ·38	·34	·36
5450	8½ × 3½ × ·60	·52	6 × 3½ × ·48	·38	·42	4½ × 3½ × ·38	·46	·40	4 × 4 × ·52	·48	5½ × 3½ × ·40	·34	·38
6500	9 × 3½ × ·64	·54	6½ × 3½ × ·50	·40	·44	5 × 3½ × ·40	·48	·40	4 × 4 × ·54	·50	6 × 3½ × ·42	·36	·40
7700	9½ × 3½ × ·66	·56	7 × 3½ × ·50	·40	·46	6 × 3½ × ·42	·48	·40	4 × 4 × ·56	·50	6 × 3½ × ·46	·38	·40

CENTRE and SIDE KEELSONS in TUGS. TABLE 11

FIRST LONGITUDINAL NUMERAL. L × D	CENTRE KEELSON ON TOP OF FLOORS.		SIDE KEELSON ON TOP OF FLOORS.	FIRST LONGITUDINAL NUMERAL. L × D	CENTRE KEELSON ON TOP OF FLOORS.		SIDE KEELSON ON TOP OF FLOORS.
	Single Channel.	Double Bulb Angles.	Single Angle.		Single Channel.	Double Bulb Angles.	Single Angle.
	Inches.	Inches.	Inches.		Inches.	Inches.	Inches.
850	8 × 3½ × 3½ × ·40	6 × 3 × ·38	5 × 3 × ·38	1700	12 × 3½ × 3½ × ·48	8 × 3½ × ·42	5 × 4 × ·40
1050	9 × 3½ × 3½ × ·42	6 × 3 × ·40	5 × 4 × ·38	2000	12 × 3½ × 3½ × ·50	8 × 3½ × ·44	5 × 4 × ·42
1250	10 × 3½ × 3½ × ·44	6 × 3½ × ·42	5 × 4 × ·38	2300		8 × 3½ × ·46	5 × 4 × ·46
1450	11 × 3½ × 3½ × ·46	7 × 3½ × ·42	5 × 4 × ·38	2600		8 × 3½ × ·50	5 × 4 × ·50

In the boiler room the thicknesses of the centre and side keelson plates and bars not covered by cement are to be increased by ·10 inch beyond those given in Tables 10 and 11.

LLOYD'S REGISTER OF SHIPPING, LONDON.—16*th June*, 1927.

BEAMS fitted to EVERY FRAME.

TABLE 12

(See Continuation.)

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT UPPER DECKS OF SINGLE DECK VESSELS.				BEAMS AT UPPER DECKS IN FULL SCANTLING VESSELS HAVING MORE THAN ONE DECK, IN COMPLETE SUPERSTRUCTURE VESSELS FORWARD OF ¼th LENGTH FROM FORWARD AND AT FORECASTLE DECKS.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.	SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.		With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20	21	ANGLES	4 ×3 ×·30	3½×3 ×·28	3 ×3 ×·26	·30				
22	21		4 ×3 ×·32	3½×3 ×·30	3 ×3 ×·28	·30				
24	21½		4½×3 ×·32	4 ×3 ×·30	3 ×3 ×·30	·32	4½×3 ×·30	3½×3 ×·30	3 ×3 ×·30	·30
26	22		5 ×3 ×·32	4½×3 ×·30	3½×3 ×·30	·32	5 ×3 ×·30	4 ×3 ×·30	3½×3 ×·30	·30
28	22		5½×3 ×·32	4½×3 ×·34	3½×3 ×·30	·32	5 ×3 ×·32	4 ×3 ×·32	3½×3 ×·30	·32
30	22½		6 ×3 ×·34	5 ×3 ×·34	4 ×3 ×·30	·34	5 ×3 ×·34	4½×3 ×·32	4 ×3 ×·30	·32
32	22½		5½×3 ×·34	5 ×3 ×·36	4 ×3 ×·32	·34	5½×3 ×·34	5 ×3 ×·32	4 ×3 ×·32	·34
34	23		6 ×3 ×·36	5½×3 ×·36	4 ×3 ×·34	·36	6 ×3 ×·36	5 ×3 ×·34	4 ×3 ×·34	·34
36	23½		6½×3 ×·38	6 ×3 ×·36	4½×3 ×·34	·38	5½×3 ×·34	5½×3 ×·34	4½×3 ×·34	·34
38	24		7 ×3 ×·42	5½×3 ×·36	5 ×3 ×·34	·40	6 ×3 ×·36	6 ×3 ×·36	5 ×3 ×·34	·36
40	24½		7½×3 ×·44	6 ×3 ×·36	5½×3 ×·34	·42	6½×3 ×·36	6½×3 ×·36	5½×3 ×·34	·36
42	25		8 ×3 ×·44	6 ×3 ×·40	5½×3 ×·36	·44	7 ×3 ×·38	5½×3 ×·34	5½×3 ×·36	·38
44	25½		8½×3½×·46	6½×3½×·40	6 ×3 ×·36	·46	7½×3 ×·40	6 ×3 ×·34	6 ×3 ×·36	·38
46	26		9 ×3½×·48	7 ×3½×·40	5½×3 ×·34	·48	8 ×3 ×·42	6 ×3 ×·38	5½×3 ×·34	·40
48	27		9½×3½×·50	7½×3½×·40	6 ×3½×·36	·50	8½×3 ×·44	6½×3 ×·38	6 ×3 ×·36	·40
50	28		10 ×3½×·52	7½×3½×·44	6 ×3½×·40	·52	9 ×3½×·46	7 ×3½×·40	6 ×3½×·40	·42
52	28½		10½×3½×·54	8 ×3½×·44	6½×3½×·40	·52	9½×3½×·48	7 ×3½×·46	6½×3½×·40	·44
54	29		11 ×3½×·54	8 ×3½×·48	7 ×3½×·42	·54	10 ×3½×·50	7½×3½×·46	7 ×3½×·42	·46
56	29½			8½×3½×·48	7½×3½×·42	·54	10½×3½×·50	8 ×3½×·46	7½×3½×·42	·46
58	30			8½×3½×·52	7½×3½×·46	·56	10½×3½×·54	8 ×3½×·52	7½×3½×·46	·48
60	31			9 ×3½×·52	8 ×3½×·46	·56	11 ×3½×·54	8½×3½×·54	8 ×3½×·46	·48
62	32							9 ×3½×·52	8 ×3½×·48	·48
64	32½							9 ×3½×·54	8½×3½×·46	·50
66	33							9½×3½×·54	8½×3½×·48	·50
68	33½								9 ×3½×·46	·50
70	34								9 ×3½×·48	·52
72	34½								9 ×3½×·50	·52
74	35								9½×3½×·50	·52
76	35½								9½×3½×·54	·54
78	36								10 ×3½×·52	·54
80	36	BULB ANGLES							10 ×3½×·54	·56

BEAMS fitted to EVERY FRAME.

TABLE 12

(See Continuation.)

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT UPPER DECKS ABAFT $\frac{1}{8}$th LENGTH FROM FORWARD IN COMPLETE SUPERSTRUCTURE VESSELS, AT LONG BRIDGES AND AT POOP DECKS COVERING MACHINERY OPENINGS.				BEAMS AT SHORT BRIDGES AND AT POOP DECKS NOT COVERING MACHINERY OPENINGS.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.	SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.		With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20	21	ANGLES								
22	21									
24	$21\frac{1}{2}$		4 ×3 ×·30	$3\frac{1}{2}$×3 ×·30	3 ×3 ×·30	·30				
26	22		$4\frac{1}{2}$×3 ×·30	4 ×3 ×·30	$3\frac{1}{2}$×3 ×·30	·30	$3\frac{1}{2}$×3 ×·28	3 ×3 ×·28	3 ×3 ×·26	·30
28	22		5 ×3 ×·30	4 ×3 ×·30	$3\frac{1}{2}$×3 ×·30	·32	$3\frac{1}{2}$×3 ×·30	3 ×3 ×·30	3 ×3 ×·28	·30
30	$22\frac{1}{2}$		5 ×3 ×·32	$4\frac{1}{2}$×3 ×·30	4 ×3 ×·30	·32	4 ×3 ×·30	$3\frac{1}{2}$×3 ×·30	3 ×3 ×·30	·30
32	$22\frac{1}{2}$		5 ×3 ×·34	$4\frac{1}{2}$×3 ×·32	4 ×3 ×·32	·34	$4\frac{1}{2}$×3 ×·30	4 ×3 ×·30	$3\frac{1}{2}$×3 ×·30	·30
34	23		$5\frac{1}{2}$×3 ×·34	$4\frac{1}{2}$×3 ×·34	4 ×3 ×·34	·34	$4\frac{1}{2}$×3 ×·34	4 ×3 ×·32	$3\frac{1}{2}$×3 ×·30	·32
36	$23\frac{1}{2}$		6 ×3 ×·36	5 ×3 ×·34	$4\frac{1}{2}$×3 ×·34	·34	5 ×3 ×·34	$4\frac{1}{2}$×3 ×·32	4 ×3 ×·30	·32
38	24	BULB ANGLES	$5\frac{1}{2}$×3 ×·34	$5\frac{1}{2}$×3 ×·34	5 ×3 ×·34	·36	$5\frac{1}{2}$×3 ×·34	$4\frac{1}{2}$×3 ×·34	4 ×3 ×·30	·34
40	$24\frac{1}{2}$		6 ×3 ×·36	6 ×3 ×·34	$5\frac{1}{2}$×3 ×·34	·36	6 ×3 ×·36	5 ×3 ×·34	4 ×3 ×·32	·34
42	25		$6\frac{1}{2}$×3 ×·36	$6\frac{1}{2}$×3 ×·36	$5\frac{1}{2}$×3 ×·36	·38	$5\frac{1}{2}$×3 ×·34	$5\frac{1}{2}$×3 ×·34	$4\frac{1}{2}$×3 ×·32	·34
44	$25\frac{1}{2}$		7 ×3 ×·38	$5\frac{1}{2}$×3 ×·36	6 ×3 ×·36	·38	6 ×3 ×·34	6 ×3 ×·34	5 ×3 ×·32	·36
46	26		$7\frac{1}{2}$×3 ×·40	6 ×3 ×·36	$5\frac{1}{2}$×3 ×·34	·40	6 ×3 ×·40	$6\frac{1}{2}$×3 ×·34	$5\frac{1}{2}$×3 ×·32	·36
48	27		8 ×3 ×·40	6 ×3 ×·40	6 ×3 ×·36	·40	$6\frac{1}{2}$×3 ×·40	$5\frac{1}{2}$×3 ×·34	6 ×3 ×·32	·38
50	28		$8\frac{1}{2}$×$3\frac{1}{2}$×·42	$6\frac{1}{2}$×$3\frac{1}{2}$×·40	6 ×$3\frac{1}{2}$×·40	·42	7 ×3 ×·40	6 ×3 ×·34	6 ×3 ×·36	·38
52	$28\frac{1}{2}$		9 ×$3\frac{1}{2}$×·44	7 ×$3\frac{1}{2}$×·40	$6\frac{1}{2}$×$3\frac{1}{2}$×·40	·44	$7\frac{1}{2}$×3 ×·42	$6\frac{1}{2}$×3 ×·34	$5\frac{1}{2}$×3 ×·34	·40
54	29		9 ×$3\frac{1}{2}$×·48	$7\frac{1}{2}$×$3\frac{1}{2}$×·42	7 ×$3\frac{1}{2}$×·42	·46	8 ×3 ×·44	$6\frac{1}{2}$×3 ×·38	$5\frac{1}{2}$×3 ×·36	·40
56	$29\frac{1}{2}$		$9\frac{1}{2}$×$3\frac{1}{2}$×·48	8 ×$3\frac{1}{2}$×·42	$7\frac{1}{2}$×$3\frac{1}{2}$×·42	·46	$8\frac{1}{2}$×3 ×·46	7 ×3 ×·38	6 ×3 ×·34	·40
58	30		$9\frac{1}{2}$×$3\frac{1}{2}$×·54	8 ×$3\frac{1}{2}$×·46	$7\frac{1}{2}$×$3\frac{1}{2}$×·46	·48		$7\frac{1}{2}$×3 ×·38	6 ×3 ×·36	·42
60	31		10 ×$3\frac{1}{2}$×·54	$8\frac{1}{2}$×$3\frac{1}{2}$×·46	8 ×$3\frac{1}{2}$×·46	·48		8 ×3 ×·40	$6\frac{1}{2}$×3 ×·36	·42
62	32			$8\frac{1}{2}$×$3\frac{1}{2}$×·48	8 ×$3\frac{1}{2}$×·48	·48		$8\frac{1}{2}$×3 ×·40	$6\frac{1}{2}$×3 ×·40	·42
64	$32\frac{1}{2}$			9 ×$3\frac{1}{2}$×·48	$8\frac{1}{2}$×$3\frac{1}{2}$×·46	·50		9 ×3 ×·42	7 ×3 ×·40	·44
66	33			9 ×$3\frac{1}{2}$×·52	$8\frac{1}{2}$×$3\frac{1}{2}$×·48	·50			7 ×3 ×·42	·44
68	$33\frac{1}{2}$				9 ×$3\frac{1}{2}$×·46	·50			$7\frac{1}{2}$×3 ×·40	·44
70	34				9 ×$3\frac{1}{2}$×·48	·52			$7\frac{1}{2}$×3 ×·42	·46
72	$34\frac{1}{2}$				9 ×$3\frac{1}{2}$×·50	·52			8 ×3 ×·40	·46
74	35				$9\frac{1}{2}$×$3\frac{1}{2}$×·50	·52			8 ×3 ×·44	·48
76	$35\frac{1}{2}$				$9\frac{1}{2}$×$3\frac{1}{2}$×·54	·54			$8\frac{1}{2}$×3 ×·44	·48
78	36				10 ×$3\frac{1}{2}$×·52	·54			9 ×3 ×·44	·50
80	36				10 ×$3\frac{1}{2}$×·54	·56			9 ×3 ×·48	·50

TABLE 12

BEAMS fitted to EVERY FRAME. *(Concluded.)*

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT ALL DECKS ON WHICH CARGO IS CARRIED.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.
20	21	ANGLES				
22	21					
24	$21\frac{1}{2}$					
26	22		$5\frac{1}{2}\times3\times\cdot30$	$4\frac{1}{2}\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	·30
28	22		$6\times3\times\cdot30$	$5\times3\times\cdot30$	$3\frac{1}{2}\times3\times\cdot30$	·32
30	$22\frac{1}{2}$		$6\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot30$	$4\times3\times\cdot30$	·32
32	$22\frac{1}{2}$	BULB ANGLES	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot32$	$4\times3\times\cdot32$	·34
34	23		$6\times3\times\cdot36$	$6\times3\times\cdot32$	$4\times3\times\cdot34$	·36
36	$23\frac{1}{2}$		$6\frac{1}{2}\times3\times\cdot38$	$6\times3\times\cdot36$	$4\frac{1}{2}\times3\times\cdot34$	·36
38	24		$7\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot34$	$5\times3\times\cdot34$	·38
40	$24\frac{1}{2}$		$7\frac{1}{2}\times3\times\cdot40$	$6\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot34$	·38
42	25		$8\times3\times\cdot40$	$6\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot36$	·40
44	$25\frac{1}{2}$		$8\frac{1}{2}\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot38$	$6\times3\times\cdot36$	·42
46	26		$9\times3\times\cdot44$	$7\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot34$	·44
48	27		$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$7\frac{1}{2}\times3\times\cdot38$	$6\times3\times\cdot36$	·44
50	28		$10\times3\frac{1}{2}\times\cdot48$	$7\frac{1}{2}\times3\times\cdot42$	$6\times3\times\cdot40$	·46
52	$28\frac{1}{2}$		$10\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$8\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot40$	·46
54	29		$11\times3\frac{1}{2}\times\cdot50$	$8\times3\times\cdot46$	$7\times3\times\cdot42$	·46
56	$29\frac{1}{2}$		$11\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$8\frac{1}{2}\times3\times\cdot46$	$7\frac{1}{2}\times3\times\cdot42$	·48
58	30			$8\frac{1}{2}\times3\times\cdot50$	$7\frac{1}{2}\times3\times\cdot46$	·48
60	31			$9\times3\times\cdot50$	$8\times3\times\cdot46$	·48
62	32			$9\times3\times\cdot54$	$8\times3\times\cdot48$	·48
64	$32\frac{1}{2}$			$9\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\times\cdot46$	·50
66	33			$10\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\times\cdot48$	·50
68	$33\frac{1}{2}$				$9\times3\times\cdot46$	·50
70	34				$9\times3\times\cdot48$	·52
72	$34\frac{1}{2}$				$9\times3\times\cdot50$	·52
74	35				$9\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	·52
76	$35\frac{1}{2}$				$9\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	·54
78	36				$10\times3\frac{1}{2}\times\cdot52$	·54
80	36				$10\times3\frac{1}{2}\times\cdot54$	·56

BEAMS fitted to ALTERNATE FRAMES.

TABLE 13

(See Continuation.)

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT UPPER DECKS OF SINGLE DECK VESSELS.				BEAMS AT UPPER DECKS IN FULL SCANTLING VESSELS HAVING MORE THAN ONE DECK, IN COMPLETE SUPERSTRUCTURE VESSELS FORWARD OF ¼th LENGTH FROM FORWARD, AND AT FORECASTLE DECKS.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.	SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.		With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20	42	ANGLES	5½ × 3 × ·32	5 × 3 × ·32	4 × 3 × ·30	·30				
22	42		5½ × 3 × ·36	5 × 3 × ·34	4 × 3 × ·32	·30				
24	43		6 × 3 × ·36	5½ × 3 × ·34	4½ × 3 × ·32	·32	6 × 3 × ·36	5 × 3 × ·32	4½ × 3 × ·32	·30
26	44		6½ × 3 × ·36	6 × 3 × ·34	5 × 3 × ·32	·32	6 × 3 × ·40	5½ × 3 × ·32	5 × 3 × ·32	·30
28	44	BULB ANGLES	6 × 3 × ·34	6½ × 3 × ·34	5 × 3 × ·34	·34	6½ × 3 × ·36	6 × 3 × ·32	5 × 3 × ·34	·32
30	45		6½ × 3 × ·34	5½ × 3 × ·34	5½ × 3 × ·32	·36	5½ × 3 × ·34	6 × 3 × ·36	5½ × 3 × ·32	·34
32	45		7½ × 3 × ·36	5½ × 3 × ·38	5½ × 3 × ·36	·38	6 × 3 × ·34	6½ × 3 × ·36	5½ × 3 × ·36	·36
34	46		8 × 3 × ·42	6 × 3 × ·38	6 × 3 × ·36	·40	6½ × 3 × ·40	5½ × 3 × ·34	6 × 3 × ·36	·36
36	47		8½ × 3 × ·48	6½ × 3 × ·38	6½ × 3 × ·36	·42	7½ × 3 × ·36	6 × 3 × ·34	6½ × 3 × ·36	·38
38	48						8 × 3 × ·42	6½ × 3 × ·34	5½ × 3 × ·34	·38
40	49						8½ × 3 × ·46	7 × 3 × ·34	6 × 3 × ·34	·40
42	50						9 × 3 × ·52	7½ × 3 × ·36	6½ × 3 × ·36	·42
44	51						10 × 3½ × ·48	8 × 3 × ·38	7 × 3 × ·36	·44
46	52						10½ × 3½ × ·52	8 × 3 × ·46	7½ × 3 × ·38	·46
48	54						11 × 3½ × ·58	8½ × 3 × ·48	8 × 3 × ·40	·48
50	56						12 × 3½ × ·56	9 × 3½ × ·50	8½ × 3½ × ·42	·50
52	57							9½ × 3½ × ·52	9 × 3½ × ·44	·52
54	58							10 × 3½ × ·52	9½ × 3½ × ·46	·52
56	59							10½ × 3½ × ·56	10 × 3½ × ·50	·54
58	60							11 × 3½ × ·56	10½ × 3½ × ·52	·54

BEAMS fitted to ALTERNATE FRAMES.

TABLE 13

(See Continuation.)

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT UPPER DECKS ABAFT $\frac{1}{8}$th LENGTH FROM FORWARD IN COMPLETE SUPERSTRUCTURE VESSELS, AT LONG BRIDGES AND AT POOP DECKS COVERING MACHINERY OPENINGS.				BEAMS AT SHORT BRIDGES AND AT POOP DECKS NOT COVERING MACHINERY OPENINGS.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.	SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.		With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20	42	ANGLES								
22	42									
24	43		$5\frac{1}{2}\times3\times\cdot34$	$5\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot32$	·30				
26	44		$6\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot32$	$5\times3\times\cdot32$	·30	$4\frac{1}{2}\times3\times\cdot32$	$4\times3\times\cdot32$	$4\times3\times\cdot30$	·30
28	44		$6\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot34$	$5\times3\times\cdot34$	·32	$5\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot32$	$4\times3\times\cdot32$	·30
30	45		$6\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot32$	·34	$5\frac{1}{2}\times3\times\cdot34$	$5\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot32$	·32
32	45		$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot36$	·36	$6\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot32$	$4\frac{1}{2}\times3\times\cdot34$	·32
34	46		$6\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot36$	·36	$6\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot34$	·34
36	47		$6\frac{1}{2}\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot34$	$6\frac{1}{2}\times3\times\cdot36$	·38	$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot36$	$5\times3\times\cdot36$	·34
38	48		$7\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot34$	·38	$6\times3\times\cdot34$	$6\times3\times\cdot40$	$5\frac{1}{2}\times3\times\cdot36$	·36
40	49		$8\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot34$	·40	$6\frac{1}{2}\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot38$	·38
42	50		$8\frac{1}{2}\times3\times\cdot46$	$7\times3\times\cdot36$	$6\frac{1}{2}\times3\times\cdot36$	·42	$7\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot34$	$6\times3\times\cdot38$	·38
44	51	BULB ANGLES	$9\times3\times\cdot52$	$7\frac{1}{2}\times3\times\cdot40$	$7\times3\times\cdot36$	·44	$8\times3\times\cdot40$	$6\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot34$	·40
46	52		$10\times3\frac{1}{2}\times\cdot48$	$8\times3\times\cdot42$	$7\frac{1}{2}\times3\times\cdot38$	·46	$8\frac{1}{2}\times3\times\cdot42$	$7\times3\times\cdot34$	$6\times3\times\cdot34$	·42
48	54		$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$8\frac{1}{2}\times3\times\cdot44$	$8\times3\times\cdot40$	·48	$9\times3\times\cdot44$	$7\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot40$	·44
50	56		$11\times3\frac{1}{2}\times\cdot56$	$9\times3\frac{1}{2}\times\cdot46$	$8\frac{1}{2}\times3\frac{1}{2}\times\cdot42$	·50	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$8\times3\times\cdot38$	$6\frac{1}{2}\times3\times\cdot38$	·46
52	57		$12\times3\frac{1}{2}\times\cdot54$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	$9\times3\frac{1}{2}\times\cdot44$	·52	$10\times3\frac{1}{2}\times\cdot50$	$8\frac{1}{2}\times3\times\cdot42$	$7\frac{1}{2}\times3\times\cdot36$	·48
54	58			$10\times3\frac{1}{2}\times\cdot50$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	·52	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$8\frac{1}{2}\times3\times\cdot48$	$7\frac{1}{2}\times3\times\cdot40$	·50
56	59			$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$10\times3\frac{1}{2}\times\cdot50$	·54	$11\times3\frac{1}{2}\times\cdot60$	$9\times3\times\cdot52$	$8\times3\times\cdot38$	·52
58	60			$11\times3\frac{1}{2}\times\cdot54$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	·54	$12\times3\frac{1}{2}\times\cdot52$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$8\frac{1}{2}\times3\times\cdot40$	·52

BEAMS fitted to ALTERNATE FRAMES. TABLE 13 *(Concluded.)*

BREADTH OF DECK AMIDSHIPS.	SPACING OF BEAMS.		BEAMS AT ALL DECKS ON WHICH CARGO IS CARRIED.			
			SIZE OF BEAMS AMIDSHIPS.			Thickness of Beam Knees.
			With One Row of Pillars.	With Two Rows of Pillars.	With Three Rows of Pillars.	
Feet.	Inches.		Inches.	Inches.	Inches.	Inches.
20	42	ANGLES				
22	42					
24	43					
26	44		$5\frac{1}{2}\times3\times\cdot34$	$6\times3\times\cdot36$	$5\times3\times\cdot32$	·34
28	44		$6\times3\times\cdot36$	$6\frac{1}{2}\times3\times\cdot36$	$5\times3\times\cdot34$	·36
30	45		$6\frac{1}{2}\times3\times\cdot38$	$5\frac{1}{2}\times3\times\cdot34$	$5\frac{1}{2}\times3\times\cdot32$	·38
32	45		$7\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot36$	·40
34	46		$8\times3\times\cdot42$	$6\frac{1}{2}\times3\times\cdot36$	$6\times3\times\cdot36$	·42
36	47		$8\frac{1}{2}\times3\times\cdot48$	$7\times3\times\cdot36$	$6\frac{1}{2}\times3\times\cdot36$	·44
38	48		$9\frac{1}{2}\times3\frac{1}{2}\times\cdot44$	$7\frac{1}{2}\times3\times\cdot36$	$5\frac{1}{2}\times3\times\cdot34$	·46
40	49		$10\times3\frac{1}{2}\times\cdot48$	$8\times3\times\cdot38$	$6\times3\times\cdot34$	·48
42	50		$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$8\times3\times\cdot46$	$6\frac{1}{2}\times3\times\cdot36$	·50
44	51		$11\times3\frac{1}{2}\times\cdot56$	$8\frac{1}{2}\times3\times\cdot48$	$7\times3\times\cdot36$	·50
46	52		$12\times3\frac{1}{2}\times\cdot52$	$9\times3\times\cdot52$	$7\frac{1}{2}\times3\times\cdot38$	·52
48	54			$9\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$8\times3\times\cdot40$	·52
50	56			$10\times3\frac{1}{2}\times\cdot52$	$8\frac{1}{2}\times3\times\cdot42$	·54
52	57			$10\frac{1}{2}\times3\frac{1}{2}\times\cdot52$	$9\times3\times\cdot44$	·54
54	58			$10\frac{1}{2}\times3\frac{1}{2}\times\cdot60$	$9\frac{1}{2}\times3\frac{1}{2}\times\cdot46$	·56
56	59			$11\times3\frac{1}{2}\times\cdot60$	$10\times3\frac{1}{2}\times\cdot50$	·56
58	60	BULB ANGLES		$12\times3\frac{1}{2}\times\cdot52$	$10\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	·56

DIAMETERS of SOLID IRON or STEEL PILLARS FITTED TWO FRAME SPACES APART.

TABLE 14

(See Continuation.)

LENGTH OF PILLAR.	ONE ROW OF PILLARS.													TWO ROWS OF PILLARS.										
	To Beams of Upper Deck.							To Beams of Second Deck.						To Beams of Upper Deck.				To Beams of Second Deck.				To Beams of Third Deck.			
	Length of Beam Amidships in feet.													Length of Beam Amidships in feet.										
	20	26	32	38	44	50	56	26	32	38	44	50	56	50	56	62	68	50	56	62	68	50	56	62	68
Feet.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
8	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$
10	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$
12	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$
14	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	4	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5
16	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$		4	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{7}{8}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{7}{8}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{3}{8}$
18		$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4			$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$
20		$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$				5	$5\frac{1}{4}$	$5\frac{1}{2}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6
22		$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$					$5\frac{1}{2}$	$5\frac{3}{4}$	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$
24		$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$						6	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$
26			$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5							$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$		$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$
28				$4\frac{7}{8}$	5	$5\frac{1}{8}$	$5\frac{1}{4}$							$4\frac{7}{8}$	5	$5\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$			$6\frac{3}{4}$	7
30					$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{2}$							$5\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{2}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$				
32						$5\frac{5}{8}$	$5\frac{3}{4}$							$5\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{5}{8}$	$5\frac{3}{4}$	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$	7				

The pillars to beams of detached Superstructure decks may be $\frac{1}{8}$ inch less in diameter than those required by above Table for beams to Upper decks.

DOUBLE ANGLE GIRDERS at HEADS of CLOSELY SPACED PILLARS.

FRAME SPACING.	SIZE OF ANGLES IN INCHES.
Inches. 23	3 × 3 × ·30
27	$3\frac{1}{2}$ × $3\frac{1}{2}$ × ·38
31	4 × 4 × ·46
35	4 × 4 × ·54

DIAMETERS of SOLID IRON or STEEL PILLARS FITTED TWO FRAME SPACES APART.

TABLE 14
(Concluded.)

LENGTH OF PILLAR.	TWO ROWS OF PILLARS.				THREE ROWS OF PILLARS.																			
	To Beams of Fourth Deck.				To Beams of Upper Deck.				To Beams of Second Deck.				To Beams of Third Deck.				To Beams of Fourth Deck.				To Beams of Fifth Deck.			
	Length of Beam Amidships in feet.				Length of Beam Amidships in feet.																			
	50	56	62	68	62	68	74	80	62	68	74	80	62	68	74	80	62	68	74	80	62	68	74	80
Feet.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
8	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$
10	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5
12	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	$5\frac{1}{8}$	$2\frac{7}{8}$	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	$5\frac{1}{8}$	$4\frac{7}{8}$	5	$5\frac{1}{8}$	$5\frac{3}{8}$
14	$4\frac{7}{8}$	$5\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{3}{8}$	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5	$4\frac{7}{8}$	$5\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{8}$	$5\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{5}{8}$
16	$5\frac{1}{8}$	$5\frac{3}{8}$	$5\frac{5}{8}$	$5\frac{3}{4}$					$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{8}$	$5\frac{3}{8}$	$5\frac{5}{8}$	$5\frac{3}{4}$	$5\frac{3}{8}$	$5\frac{5}{8}$	$5\frac{7}{8}$	6
18	$5\frac{3}{8}$	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$					$4\frac{1}{2}$	$4\frac{3}{4}$	5		5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{3}{8}$	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$
20	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$					$4\frac{3}{4}$	5			$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$
22	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$					5	$5\frac{1}{4}$			$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{7}{8}$
24	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{7}{8}$					$5\frac{1}{4}$	$5\frac{1}{2}$			$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{7}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{7}{8}$	
26									$5\frac{1}{2}$				6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$								
28									$5\frac{3}{4}$				$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$	7								
30									6				$6\frac{1}{2}$	$6\frac{3}{4}$	7									
32													$6\frac{3}{4}$	7										

The pillars to beams of detached Superstructure decks may be $\frac{1}{8}$ inch less in diameter than those required by above Table for beams to Upper decks.

EQUIVALENT PILLARS of IRON and STEEL.

Solid Pillars as per Table. Diameter....	Inches. $2\frac{1}{8}$	Inches. $2\frac{1}{4}$	Inches. $2\frac{3}{8}$	Inches. $2\frac{1}{2}$	Inches. $2\frac{5}{8}$	Inches. $2\frac{3}{4}$	Inches. $2\frac{7}{8}$	Inches. 3	Inches. $3\frac{1}{8}$	Inches. $3\frac{1}{4}$	Inches. $3\frac{3}{8}$	Inches. $3\frac{1}{2}$	Inches. $3\frac{5}{8}$
Equivalent Hollow Pillars. Diameter and Thickness.....	$2\frac{1}{2}\times\frac{5}{16}$	$2\frac{3}{4}\times\frac{5}{16}$	$3\times\frac{5}{16}$	$3\times\frac{6}{16}$	$3\frac{1}{4}\times\frac{6}{16}$	$3\frac{1}{2}\times\frac{6}{16}$	$3\frac{3}{4}\times\frac{6}{16}$	$4\times\frac{7}{16}$	$4\frac{1}{4}\times\frac{7}{16}$	$4\frac{1}{2}\times\frac{7}{16}$	$4\frac{3}{4}\times\frac{7}{16}$	$5\times\frac{7}{16}$	$5\frac{1}{2}\times\frac{7}{16}$

Solid Pillars as per Table. Diameter....	Inches. $3\frac{3}{4}$	Inches. $3\frac{7}{8}$	Inches. 4	Inches. $4\frac{1}{4}$	Inches. $4\frac{1}{2}$	Inches. $4\frac{3}{4}$	Inches. 5	Inches. $5\frac{1}{4}$	Inches. $5\frac{1}{2}$	Inches. $5\frac{3}{4}$	Inches. 6	Inches. $6\frac{1}{4}$	Inches. $6\frac{1}{2}$	Inches. $6\frac{3}{4}$
Equivalent Hollow Pillars. Diameter and Thickness.....	$5\frac{3}{4}\times\frac{8}{16}$	$6\times\frac{8}{16}$	$6\times\frac{9}{16}$	$6\frac{1}{4}\times\frac{9}{16}$	$6\frac{1}{2}\times\frac{9}{16}$	$6\frac{3}{4}\times\frac{9}{16}$	$7\times\frac{9}{16}$	$7\times\frac{10}{16}$	$7\frac{1}{2}\times\frac{10}{16}$	$7\frac{3}{4}\times\frac{10}{16}$	$8\frac{1}{2}\times\frac{10}{16}$	$8\frac{1}{2}\times\frac{11}{16}$	$8\frac{3}{4}\times\frac{11}{16}$	$9\times\frac{11}{16}$

The Hollow Pillars required by the above Table are to have Solid Welded Heads and Heels.

LLOYD'S REGISTER OF SHIPPING, LONDON.—13*th July*, 1922.

WIDELY SPACED STEEL PILLARS.

TABLE 15

(See Continuation.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 8				Feet. 10			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	6 ×·36	6 ×3 ×3 ×·36			6 ×·38	6 ×3 ×3 ×·38		
16	6 ×·40	6 ×3 ×3 ×·40			6½ ×·40	6 ×3½ ×3½ ×·40		
19	6½ ×·40	6 ×3½ ×3½ ×·40			7 ×·40	7 ×3½ ×3½ ×·40		
22	7 ×·40	7 ×3½ ×3½ ×·40			7½ ×·40	7 ×3½ ×3½ ×·44		4 ×4 ×·40
25	7½ ×·40	7 ×3½ ×3½ ×·44			8 ×·40	7½ ×3½ ×3½ ×·44		4 ×4 ×·42
29	8 ×·40	7½ ×3½ ×3½ ×·44		4 ×4 ×·40	8 ×·44	7½ ×3½ ×3½ ×·50		4 ×4 ×·44
33	9 ×·40	8 ×3½ ×3½ ×·46		4½ ×4½ ×·40	9 ×·42	8 ×3½ ×3½ ×·48		4½ ×4½ ×·42
37	10 ×·40	8 ×4 ×4 ×·46		5 ×5 ×·40	10 ×·42	8 ×4 ×4 ×·48		5 ×5 ×·42
42	10 ×·44	8 ×4 ×4 ×·52		5 ×5 ×·44	10 ×·46	8 ×4 ×4 ×·54		5 ×5 ×·46
47	11 ×·44	9 ×4 ×4 ×·50		5 ×5 ×·48	11 ×·48	9 ×4 ×4 ×·56		5 ×5 ×·50
52	11 ×·50	9 ×4 ×4 ×·56		5 ×5 ×·52	12 ×·46	9 ×4 ×4 ×·60		5 ×5 ×·54
58	12 ×·48	9 ×4 ×4 ×·62		5 ×5 ×·58	12 ×·50	8½ ×3½ ×3½ ×·44	10 ×·40	5 ×5 ×·60
64	13 ×·50	9½ ×3½ ×3½ ×·44	10 ×·42	6 ×6 ×·50	13 ×·50	9½ ×3½ ×3½ ×·44	11 ×·42	6 ×6 ×·50
71	13 ×·54	10 ×3½ ×3½ ×·44	11 ×·42	6 ×6 ×·54	13 ×·56	10 ×3½ ×3½ ×·46	11 ×·44	6 ×6 ×·54
78	14 ×·54	11 ×3½ ×3½ ×·44	11 ×·46	6 ×6 ×·60	14 ×·56	11 ×3½ ×3½ ×·46	11 ×·46	6 ×6 ×·60
86	15 ×·54	11 ×3½ ×3½ ×·46	12 ×·50	6 ×6 ×·64	15 ×·56	11 ×3½ ×3½ ×·48	12 ×·50	6 ×6 ×·64
94	16 ×·54	11 ×3½ ×3½ ×·50	12 ×·56	6 ×6 ×·70	16 ×·56	11 ×3½ ×3½ ×·52	12 ×·56	6 ×6 ×·70
102	17 ×·56	11 ×3½ ×3½ ×·50	12 ×·60	7 ×7 ×·60	17 ×·58	11 ×3½ ×3½ ×·52	12 ×·60	7 ×7 ×·60
110	17 ×·60	11½ ×3½ ×3½ ×·50	13 ×·60	7 ×7 ×·64	17 ×·64	11½ ×3½ ×3½ ×·52	13 ×·60	7 ×7 ×·64
118	18 ×·60	12 ×3½ ×3½ ×·50	13 ×·70	7 ×7 ×·70	18 ×·64	12 ×3½ ×3½ ×·52	13 ×·70	7 ×7 ×·70
126	18 ×·66	12 ×3½ ×3½ ×·50	13 ×·74	7 ×7 ×·74	18 ×·68	12 ×3½ ×3½ ×·52	13 ×·74	7 ×7 ×·74
134	19 ×·66			7 ×7 ×·80	19 ×·68			7 ×7 ×·80

WIDELY SPACED STEEL PILLARS.

TABLE 15

(See Continuation.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 12				Feet. 14			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	$6\frac{1}{2} \times .38$	$6 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .38$			$7 \times .38$	$7 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .38$		$4 \times 4 \times .40$
16	$7 \times .38$	$7 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .38$			$7\frac{1}{2} \times .38$	$7 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .42$		$4 \times 4 \times .42$
19	$7\frac{1}{2} \times .40$	$7 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$			$8 \times .40$	$7\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$		$4 \times 4 \times .44$
22	$8 \times .40$	$7\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$		$4 \times 4 \times .44$	$8\frac{1}{2} \times .40$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .46$		$4\frac{1}{2} \times 4\frac{1}{2} \times .40$
25	$8\frac{1}{2} \times .40$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .46$		$4\frac{1}{2} \times 4\frac{1}{2} \times .40$	$8\frac{1}{2} \times .42$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$		$4\frac{1}{2} \times 4\frac{1}{2} \times .44$
29	$8\frac{1}{2} \times .44$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$		$4\frac{1}{2} \times 4\frac{1}{2} \times .44$	$9 \times .42$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$		$5 \times 5 \times .40$
33	$9 \times .44$	$8 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$		$5 \times 5 \times .40$	$10 \times .42$	$8 \times 4 \times 4 \times .50$		$5 \times 5 \times .44$
37	$10 \times .44$	$8 \times 4 \times 4 \times .52$		$5 \times 5 \times .44$	$10 \times .48$	$9 \times 4 \times 4 \times .52$		$5 \times 5 \times .50$
42	$10 \times .50$	$9 \times 4 \times 4 \times .54$		$5 \times 5 \times .50$	$11 \times .48$	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$	$9 \times .40$	$5 \times 5 \times .54$
47	$11 \times .50$	$9 \times 4 \times 4 \times .60$		$5 \times 5 \times .54$	$12 \times .50$	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$	$10 \times .40$	$5 \times 5 \times .60$
52	$12 \times .48$	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .44$	$10 \times .40$	$5 \times 5 \times .60$	$12 \times .54$	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$10 \times .42$	$6 \times 6 \times .50$
58	$12 \times .52$	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$10 \times .42$	$6 \times 6 \times .50$	$13 \times .52$	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$11 \times .42$	$6 \times 6 \times .54$
64	$13 \times .52$	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$11 \times .42$	$6 \times 6 \times .54$	$13 \times .56$	$10 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$11 \times .44$	$6 \times 6 \times .60$
71	$14 \times .52$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$11 \times .46$	$6 \times 6 \times .60$	$14 \times .54$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$11 \times .46$	$6 \times 6 \times .64$
78	$14 \times .58$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .48$	$12 \times .48$	$6 \times 6 \times .64$	$15 \times .54$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$	$12 \times .50$	$6 \times 6 \times .70$
86	$15 \times .60$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$12 \times .50$	$6 \times 6 \times .70$	$16 \times .56$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$12 \times .56$	$7 \times 7 \times .60$
94	$16 \times .60$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$12 \times .60$	$7 \times 7 \times .60$	$17 \times .56$	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$12 \times .60$	$7 \times 7 \times .64$
102	$17 \times .60$	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$	$13 \times .60$	$7 \times 7 \times .64$	$17 \times .64$	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$13 \times .64$	$7 \times 7 \times .70$
110	$18 \times .60$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$	$13 \times .70$	$7 \times 7 \times .70$	$18 \times .64$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .52$	$13 \times .70$	$7 \times 7 \times .74$
118	$18 \times .66$			$8 \times 8 \times .64$	$19 \times .62$			$8 \times 8 \times .70$
126	$19 \times .66$			$8 \times 8 \times .70$	$19 \times .70$			$8 \times 8 \times .74$
134	$19 \times .70$			$8 \times 8 \times .74$	$20 \times .68$			

WIDELY SPACED STEEL PILLARS.

TABLE 15

(See Continuation.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 16				Feet. 18			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	7 ×·40	7 ×3½×3½×·40		4 ×4 ×·42	7½×·40	7 ×3½×3½×·44		4½×4½×·40
16	7½×·40	7 ×3½×3½×·44		4 ×4 ×·44	8 ×·40	7½×3½×3½×·44		4½×4½×·42
19	8 ×·40	7½×3½×3½×·44		4½×4½×·40	8½×·40	8 ×3½×3½×·50		5 ×5 ×·40
22	8½×·40	8 ×3½×3½×·48		4½×4½×·44	9 ×·40	8 ×3½×3½×·52		5 ×5 ×·42
25	9 ×·40	8 ×3½×3½×·50		5 ×5 ×·40	9 ×·44	8 ×3½×3½×·56		5 ×5 ×·44
29	9 ×·44	8 ×3½×3½×·54		5 ×5 ×·44	10 ×·42	8 ×4 ×4 ×·54		5 ×5 ×·50
33	10 ×·44	8 ×4 ×4 ×·54		5 ×5 ×·50	10 ×·46	9 ×4 ×4 ×·52		5 ×5 ×·54
37	10 ×·50	9 ×4 ×4 ×·54		5 ×5 ×·54	11 ×·46	9 ×4 ×4 ×·56		5 ×5 ×·60
42	11 ×·50	8½×3½×3½×·48	10×·40	5 ×5 ×·60	12 ×·48	9 ×3½×3½×·44	10×·42	6 ×6 ×·50
47	12 ×·52	9 ×3½×3½×·48	10×·42	6 ×6 ×·50	12 ×·54	9½×3½×3½×·48	10×·42	6 ×6 ×·54
52	12 ×·54	10 ×3½×3½×·48	11×·42	6 ×6 ×·54	13 ×·50	10 ×3½×3½×·48	11×·46	6 ×6 ×·60
58	13 ×·54	10½×3½×3½×·48	11×·46	6 ×6 ×·60	13 ×·56	11 ×3½×3½×·48	12×·46	6 ×6 ×·64
64	14 ×·54	11 ×3½×3½×·48	12×·50	6 ×6 ×·64	14 ×·56	11 ×3½×3½×·50	12×·52	6 ×6 ×·68
71	14 ×·58	11 ×3½×3½×·50	12×·56	6 ×6 ×·70	15 ×·56	11 ×3½×3½×·50	12×·60	7 ×7 ×·60
78	15 ×·58	11 ×3½×3½×·50	12×·60	7 ×7 ×·60	16 ×·56	11 ×3½×3½×·50	13×·56	7 ×7 ×·64
86	16 ×·60	11 ×3½×3½×·52	13×·60	7 ×7 ×·64	17 ×·56	11½×3½×3½×·50	13×·60	7 ×7 ×·70
94	17 ×·60	11½×3½×3½×·52	13×·66	7 ×7 ×·70	17 ×·62	12 ×3½×3½×·50	13×·64	7 ×7 ×·74
102	18 ×·60	12 ×3½×3½×·52	13×·70	7 ×7 ×·74	18 ×·62			7 ×7 ×·80
110	19 ×·60			7 ×7 ×·80	19 ×·62			7 ×7 ×·84
118	19 ×·66			8 ×8 ×·74	19 ×·68			8 ×8 ×·80
126	20 ×·66			8 ×8 ×·80	20 ×·68			
134					21 ×·68			

WIDELY SPACED STEEL PILLARS.

TABLE 15

(See Continuation.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 20				Feet. 22			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	8 ×·40	$7\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$		$4\frac{1}{2} \times 4\frac{1}{2} \times \cdot 42$	$8\frac{1}{2} \times \cdot 40$	8 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$		$4\frac{1}{2} \times 4\frac{1}{2} \times \cdot 44$
16	$8\frac{1}{2} \times \cdot 40$	8 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$		$4\frac{1}{2} \times 4\frac{1}{2} \times \cdot 44$	9 ×·40	8 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$		5 ×5 ×·42
19	9 ×·40	8 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$		5 ×5 ×·42	9 ×·44	8 ×4 ×4 ×·54		5 ×5 ×·44
22	9 ×·44	8 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$		5 ×5 ×·44	10 ×·40	8 ×4 ×4 ×·58		5 ×5 ×·50
25	10 ×·40	8 ×4 ×4 ×·56		5 ×5 ×·50	10 ×·42	9 ×4 ×4 ×·52		5 ×5 ×·54
29	10 ×·44	9 ×4 ×4 ×·52		5 ×5 ×·54	10 ×·46	9 ×4 ×4 ×·56		5 ×5 ×·56
33	10 ×·48	9 ×4 ×4 ×·56		5 ×5 ×·58	10 ×·50	9 ×4 ×4 ×·60		5 ×5 ×·60
37	11 ×·48	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	10×·40	6 ×6 ×·50	11 ×·50	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	10×·42	6 ×6 ×·52
42	12 ×·50	9 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	10×·42	6 ×6 ×·54	12 ×·52	9 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11×·42	6 ×6 ×·56
47	13 ×·50	10 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11×·46	6 ×6 ×·58	13 ×·52	$10\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11×·46	6 ×6 ×·60
52	13 ×·52	10 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12×·50	6 ×6 ×·62	13 ×·54	$10\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12×·50	6 ×6 ×·64
58	14 ×·52	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12×·52	6 ×6 ×·68	14 ×·54	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12×·56	6 ×6 ×·70
64	14 ×·58	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12×·60	6 ×6 ×·70	15 ×·52	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12×·60	7 ×7 ×·60
71	15 ×·58	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13×·60	7 ×7 ×·62	15 ×·60	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13×·60	7 ×7 ×·64
78	16 ×·58	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13×·68	7 ×7 ×·68	16 ×·60	11 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	13×·70	7 ×7 ×·70
86	17 ×·58	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13×·72	7 ×7 ×·72	17 ×·60	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	13×·72	7 ×7 ×·74
94	18 ×·58	12 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	13×·74	7 ×7 ×·78	18 ×·60	12 $\times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	13×·74	7 ×7 ×·80
102	18 ×·64	12 ×4 ×4 ×·56	13×·74	7 ×7 ×·82	19 ×·60	12 ×4 ×4 ×·60	13×·74	7 ×7 ×·84
110	19 ×·64	12 ×4 ×4 ×·66	14×·74	8 ×8 ×·78	19 ×·66	12 ×4 ×4 ×·68	14×·76	8 ×8 ×·80
118	20 ×·64			8 ×8 ×·82	20 ×·66			8 ×8 ×·82
126	20 ×·70				21 ×·66			
134	21 ×·70				22 ×·66			

WIDELY SPACED STEEL PILLARS.

TABLE 15

(See Continuation.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 24				Feet. 26			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	9×·40	8 ×4 ×4 ×·54		5×5×·44	9×·44	8 ×4 ×4 ×·56		5×5×·50
16	9×·44	8 ×4 ×4 ×·56		5×5×·44	10×·40	9 ×4 ×4 ×·52		5×5×·50
19	10×·40	9 ×4 ×4 ×·50		5×5×·50	10×·44	9 ×4 ×4 ×·56		5×5×·54
22	10×·42	9 ×4 ×4 ×·52		5×5×·52	10×·46	9 ×4 ×4 ×·58		5×5×·54
25	10×·44	9 ×4 ×4 ×·56		5×5×·54	10×·48	9 ×4 ×4 ×·60		5×5×·60
29	10×·48	9 ×4 ×4 ×·60		5×5×·60	10×·50	8½×3½×3½×·48	10×·42	6×6×·50
33	11×·48	8½×3½×3½×·48	10×·42	6×6×·50	11×·50	9 ×3½×3½×·48	11×·42	6×6×·54
37	12×·48	9 ×3½×3½×·48	11×·42	6×6×·54	12×·50	9½×3½×3½×·48	11×·46	6×6×·58
42	12×·54	10 ×3½×3½×·48	11×·44	6×6×·60	13×·50	11 ×3½×3½×·48	11×·50	6×6×·62
47	13×·54	11 ×3½×3½×·48	12×·50	6×6×·64	13×·56	11 ×3½×3½×·50	12×·52	6×6×·66
52	13×·58	11 ×3½×3½×·50	12×·56	6×6×·68	14×·52	11 ×3½×3½×·50	12×·56	6×6×·70
58	14×·58	11 ×3½×3½×·50	12×·60	6×6×·70	15×·52	11 ×3½×3½×·50	12×·60	7×7×·60
64	15×·56	11 ×3½×3½×·50	13×·60	7×7×·62	15×·60	11½×3½×3½×·50	13×·60	7×7×·64
71	16×·56	11 ×3½×3½×·52	13×·70	7×7×·68	16×·60	11½×3½×3½×·50	13×·70	7×7×·70
78	17×·56	11½×3½×3½×·52	13×·74	7×7×·72	17×·60	12 ×3½×3½×·50	13×·74	7×7×·74
86	17×·64	12 ×3½×3½×·54	13×·74	7×7×·78	18×·60	12 ×4 ×4 ×·60	13×·74	7×7×·80
94	18×·64	12 ×4 ×4 ×·56	13×·74	7×7×·82	18×·66	12 ×4 ×4 ×·66	13×·74	7×7×·84
102	19×·64	12 ×4 ×4 ×·68	14×·76	7×7×·84	19×·66	12 ×4 ×4 ×·72	14×·76	8×8×·80
110	19×·68			8×8×·80	20×·66			
118	20×·68			8×8×·84	21×·66			
126	21×·68				22×·66			
134	22×·68				22×·70			

WIDELY SPACED STEEL PILLARS. TABLE 15 (Concluded.)

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH AND FORM OF PILLAR.							
	Feet. 28				Feet. 30			
	Tubular.	Double Channels and Face Plates.		Four Angles.	Tubular.	Double Channels and Face Plates.		Four Angles.
	Outside Diameter.	Channels.	Plates.		Outside Diameter.	Channels.	Plates.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13	10 × ·42	9 × 4 × 4 × ·52		5 × 5 × ·54	10 × ·48	9 × 4 × 4 × ·60		6 × 6 × ·50
16	10 × ·44	9 × 4 × 4 × ·56		5 × 5 × ·54	10 × ·50	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	10 × ·42	6 × 6 × ·50
19	10 × ·48	9 × 4 × 4 × ·60		5 × 5 × ·60	11 × ·44	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	11 × ·42	6 × 6 × ·54
22	10 × ·48	$8\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	10 × ·40	6 × 6 × ·50	11 × ·44	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	11 × ·44	6 × 6 × ·54
25	11 × ·44	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	11 × ·42	6 × 6 × ·52	11 × ·48	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11 × ·46	6 × 6 × ·58
29	11 × ·48	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11 × ·44	6 × 6 × ·54	11 × ·50	$9 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11 × ·46	6 × 6 × ·60
33	12 × ·48	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	11 × ·46	6 × 6 × ·58	12 × ·50	$9\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12 × ·50	6 × 6 × ·62
37	12 × ·52	$10 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	11 × ·46	6 × 6 × ·60	12 × ·54	$10 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12 × ·50	6 × 6 × ·64
42	13 × ·52	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12 × ·50	6 × 6 × ·64	13 × ·54	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	12 × ·56	6 × 6 × ·68
47	14 × ·52	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12 × ·56	6 × 6 × ·70	14 × ·54	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12 × ·60	7 × 7 × ·60
52	14 × ·56	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	12 × ·62	7 × 7 × ·60	14 × ·60	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13 × ·60	7 × 7 × ·64
58	15 × ·56	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13 × ·64	7 × 7 × ·64	15 × ·60	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13 × ·66	7 × 7 × ·70
64	16 × ·56	$11 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	13 × ·70	7 × 7 × ·70	16 × ·60	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13 × ·70	7 × 7 × ·74
71	16 × ·62	$11\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	13 × ·74	7 × 7 × ·74	17 × ·60	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	13 × ·74	7 × 7 × ·78
78	17 × ·62	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	13 × ·74	7 × 7 × ·78	18 × ·60	12 × 4 × 4 × ·60	13 × ·74	8 × 8 × ·74
86	18 × ·62				18 × ·66			
94	19 × ·62				19 × ·66			
102	19 × ·68				20 × ·66			
110	20 × ·68				20 × ·70			
118	21 × ·68				21 × ·70			
126	22 × ·68				22 × ·70			
134								

TABLE 15A

WIDELY SPACED SOLID PILLARS in 'TWEEN DECKS.

VALUES OF $\frac{S \times B \times H}{100}$	LENGTH OF PILLAR.			
	8 Feet.		10 Feet.	
	Diameter.	Number of $\frac{7}{8}$ in. rivets in heads and heels.	Diameter.	Number of $\frac{7}{8}$ in. rivets in heads and heels.
	Inches.		Inches.	
7	3	4	$3\frac{1}{4}$	4
9	$3\frac{1}{4}$	4	$3\frac{1}{2}$	4
11	$3\frac{1}{2}$	4	$3\frac{3}{4}$	4
13	$3\frac{3}{4}$	4	4	4
16	4	4	$4\frac{1}{4}$	5
19	$4\frac{1}{4}$	5	$4\frac{1}{2}$	5
22	$4\frac{1}{2}$	5	$4\frac{3}{4}$	5
25	$4\frac{3}{4}$	5	5	6
29	5	6	$5\frac{1}{4}$	6
33	$5\frac{1}{4}$	6	$5\frac{1}{2}$	7
37	$5\frac{1}{2}$	7	$5\frac{3}{4}$	7
42	$5\frac{3}{4}$	7	6	8
47	6	8	$6\frac{1}{4}$	8
52	$6\frac{1}{4}$	8	$6\frac{1}{2}$	8
58	$6\frac{1}{2}$	8		

LLOYD'S REGISTER OF SHIPPING, LONDON.—*25th June*, 1925.

DECK GIRDERS at HEADS of WIDELY SPACED PILLARS, CHANNELS or ANGLES.

TABLE 16

(See Continuation.)

VALUES OF $\frac{S^2 \times B \times H}{100}$	Thickness of Intercostal Plate and Angle.	DEPTH OF BEAMS.							
		Inches. 5		Inches. 6		Inches. 7		Inches. 8	
		SIZE AND TYPE OF GIRDER.							
		Double Channels.	Double Angles.	Double Channels.	Double Angles.	Double Channels.	Double Angles.	Double Channels.	Double Angles.
	Inch.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
190	·34		6 ×4 ×·44		6×4 ×·40		6 ×4 ×·36		5 ×4 ×·36
220	·34		6 ×4 ×·50		6×4 ×·44		6 ×4 ×·40		6 ×4 ×·36
260	·34	7 × 3×3 ×·38	6 ×4 ×·54		6×4 ×·50		6 ×4 ×·44		6 ×4 ×·40
300	·40	7 ×3½×3½×·40	6 ×4 ×·64	7 ×3 ×3 ×·38	6×4 ×·54		6 ×4 ×·50		6 ×4 ×·44
350	·40	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6×4 ×·64	7 ×3 ×3 ×·38	6 ×4 ×·54		6 ×4 ×·50
400	·40	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6 ×4 ×·64	7 ×3 ×3 ×·38	6 ×4 ×·54
460	·40	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6 ×4 ×·64
520	·44	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60
580	·44	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64
650	·44	11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64
730	·44			11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74
810	·44			12 ×3½×3½×·60		11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70
900	·50			12 ×4 ×4 ×·64		12 ×3½×3½×·60	7 ×7 ×·90	11 ×3½×3½×·60	7 ×7 ×·80
990	·50			12 ×3½×3½×·60 Rider Plate 8×·60		12 ×4 ×4 ×·64		12 ×3½×3½×·60	7 ×7 ×·90
1090	·50			12 ×3½×3½×·70 Rider Plate 8×·70		12 ×3½×3½×·60 Rider Plate 8×·60		12 ×4 ×4 ×·64	
1200	·50			12 ×4 ×4 ×·70 Rider Plate 9×·70		12 ×3½×3½×·70 Rider Plate 8×·70		12 ×3½×3½×·60 Rider Plate 8×·60	
1320	·50			12 ×4 ×4 ×·72 Rider Plate 10×·74				12 ×3½×3½×·70 Rider Plate 8×·70	
1450	·50							12 ×4 ×4 ×·70 Rider Plate 9×·70	
1590	·50							12 ×4 ×4 ×·72 Rider Plate 10×·74	
1750	·54							12 ×4 ×4 ×·72 Rider Plate 10×·84	
1920	·54							12 ×4 ×4 ×·76 Rider Plate 11×·84	
2100	·54								
2290	·54								

DECK GIRDERS at HEADS of WIDELY SPACED PILLARS, CHANNELS or ANGLES.

TABLE 16 *(Concluded.)*

VALUES OF $\frac{S^2 \times B \times H}{100}$	Thickness of Intercostal Plate and Angle.	DEPTH OF BEAMS.							
		Inches. 9		Inches. 10		Inches. 11		Inches. 12	
		SIZE AND TYPE OF GIRDER.							
		Double Channels.	Double Angles.	Double Channels.	Double Angles.	Double Channels.	Double Angles.	Double Channels.	Double Angles.
	Inch.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
190	·34		5 ×4 ×·30		4 ×4 ×·30				
220	·34		5 ×4 ×·36		5 ×4 ×·30				
260	·34		6 ×4 ×·36		5 ×4 ×·36				
300	·40		6 ×4 ×·40		6 ×4 ×·36				
350	·40		6 ×4 ×·44		6 ×4 ×·40				
400	·40		6 ×4 ×·50		6 ×4 ×·44		6 ×4 ×·40		
460	·40	7 ×3 × 3×·38	6 ×4 ×·54		6 ×4 ×·50		6 ×4 ×·44		6 ×4 ×·40
520	·44	7 ×3½×3½×·40	6 ×4 ×·64	7 ×3 ×3 ×·38	6 ×4 ×·54		6 ×4 ×·50		6 ×4 ×·44
580	·44	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6 ×4 ×·64	7 ×3 ×3 ×·38	6 ×4 ×·54		6 ×4 ×·50
650	·44	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6 ×4 ×·64	7 ×3 ×3 ×·38	6 ×4 ×·54
730	·44	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60	7 ×3½×3½×·40	6 ×4 ×·64
810	·44	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64	7½×3½×3½×·42	6½×4½×·60
900	·50	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64	8 ×3½×3½×·46	6½×4½×·64
990	·50	11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74	9 ×3½×3½×·46	6 ×6 ×·64
1090	·50	12 ×3½×3½×·60	7 ×7 ×·90	11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70	9 ×3½×3½×·60	6 ×6 ×·74
1200	·50	12 ×4 ×4 ×·64		12 ×3½×3½×·60	7 ×7 ×·90	11 ×3½×3½×·60	7 ×7 ×·80	10 ×3½×3½×·60	7 ×7 ×·70
1320	·50	12 ×3½×3½×·60 Rider Plate 8×·60		12 ×4 ×4 ×·64		12 ×3½×3½×·60	7 ×7 ×·90	11 ×3½×3½×·60	7 ×7 ×·80
1450	·50	12 ×3½×3½×·70 Rider Plate 8×·70		12 ×3½×3½×·60 Rider Plate 8×·60		12 ×4 ×4 ×·64		12 ×3½×3½×·60	7 ×7 ×·90
1590	·50	12 ×4 ×4 ×·70 Rider Plate 9×·70		12 ×3½×3½×·70 Rider Plate 8×·70		12 ×3½×3½×·60 Rider Plate 8×·60		12 ×4 ×4 ×·64	
1750	·54	12 ×4 ×4 ×·72 Rider Plate 10×·74		12 ×4 ×4 ×·70 Rider Plate 9×·70		12 ×3½×3½×·70 Rider Plate 8×·70		12 ×3½×3½×·60 Rider Plate 8×·60	
1920	·54	12 ×4 ×4 ×·74 Rider Plate 11×·78		12 ×4 ×4 ×·72 Rider Plate 10×·74		12 ×4 ×4 ×·70 Rider Plate 9×·70		12 ×3½×3½×·70 Rider Plate 8×·70	
2100	·54					12 ×4 ×4 ×·72 Rider Plate 11×·74		12 ×4 ×4 ×·72 Rider Plate 10×·70	
2290	·54							12 ×4 ×4 ×·72 Rider Plate 11×·82	

DECK GIRDERS at HEADS of WIDELY SPACED PILLARS, BULB ANGLE FACE BARS.

TABLE 17

(See Continuation.)

VALUES OF $\frac{S^2 \times B \times H}{100}$		DEPTH AND THICKNESS OF GIRDER.								
		Inches. 12 × ·40	Inches. 13 × ·40	Inches. 14 × ·42	Inches. 15 × ·42	Inches. 16 × ·44	Inches. 17 × ·44	Inches. 18 × ·46	Inches. 19 × ·46	Inches. 20 × ·48
190	SINGLE BULB ANGLES	9 × 3 × ·44	8 × 3 × ·42	7 × 3 × ·40	6 × 3 × ·40	5½ × 3 × ·36	5 × 3 × ·34			
220		9 × 3 × ·48	8½ × 3 × ·44	7½ × 3 × ·42	7 × 3 × ·38	6 × 3 × ·38	5½ × 3 × ·34			
260		9 × 3 × ·52	9 × 3 × ·44	7½ × 3 × ·46	7 × 3 × ·42	6½ × 3 × ·40	6 × 3 × ·36			
300		9½ × 3½ × ·52	9½ × 3½ × ·46	8½ × 3 × ·44	7½ × 3 × ·44	7 × 3 × ·42	6 × 3 × ·42	5½ × 3 × ·36		
350		10½ × 3½ × ·54	9½ × 3½ × ·52	9 × 3 × ·48	8½ × 3 × ·44	7½ × 3 × ·44	7 × 3 × ·40	6 × 3 × ·40	5½ × 3 × ·36	
400		11 × 3½ × ·60	10½ × 3½ × ·54	9½ × 3½ × ·52	9 × 3 × ·50	8½ × 3 × ·44	7½ × 3 × ·44	7 × 3 × ·40	6½ × 3 × ·38	5½ × 3 × ·36
460		11½ × 3½ × ·66	11 × 3½ × ·60	10½ × 3½ × ·54	9½ × 3½ × ·52	9 × 3 × ·50	8½ × 3 × ·46	7½ × 3 × ·46	7 × 3 × ·42	6 × 3 × ·42
520	DOUBLE BULB ANGLES	8½ × 3 × ·48	12 × 3½ × ·64	11½ × 3½ × ·56	10½ × 3½ × ·56	9½ × 3½ × ·52	9 × 3 × ·50	9 × 3 × ·46	8 × 3 × ·44	7 × 3 × ·42
580		9 × 3 × ·50	8½ × 3 × ·48	12 × 3½ × ·64	11½ × 3½ × ·58	10½ × 3½ × ·56	9½ × 3½ × ·54	9 × 3 × ·54	9 × 3 × ·46	8 × 3 × ·46
650		9½ × 3½ × ·52	9 × 3 × ·52	8½ × 3 × ·48	12 × 3½ × ·66	11 × 3½ × ·64	10½ × 3½ × ·58	10 × 3½ × ·54	10 × 3½ × ·48	8½ × 3 × ·52
730		10½ × 3½ × ·54	9½ × 3½ × ·54	9 × 3 × ·52	8½ × 3 × ·50	12 × 3½ × ·68	11½ × 3½ × ·62	11 × 3½ × ·58	10 × 3½ × ·58	9½ × 3½ × ·54
810		11 × 3½ × ·62	10½ × 3½ × ·56	9½ × 3½ × ·56	9½ × 3½ × ·50	9 × 3 × ·48	12 × 3½ × ·70	12 × 3½ × ·62	11 × 3½ × ·62	10½ × 3½ × ·58
900		12 × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·54	10½ × 3½ × ·52	9 × 3½ × ·54	9 × 3 × ·50	8½ × 3 × ·48	12 × 3½ × ·66	11½ × 3½ × ·64
990			12 × 3½ × ·70	12 × 3½ × ·60	11 × 3½ × ·60	10 × 3½ × ·58	10 × 3½ × ·52	9 × 3½ × ·52	9 × 3 × ·50	8½ × 3 × ·48
1090				12 × 3½ × ·72	12 × 3½ × ·64	11 × 3½ × ·62	11 × 3½ × ·56	10½ × 3½ × ·52	9½ × 3½ × ·52	9 × 3 × ·54
1200					12 × 3½ × ·74	12 × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56	9½ × 3½ × ·56
1320							12 × 3½ × ·68	11½ × 3½ × ·64	11 × 3½ × ·60	11 × 3½ × ·56
1450								12 × 3½ × ·68	11½ × 3½ × ·64	11 × 3½ × ·62
1590								12 × 3½ × ·72	12 × 3½ × ·68	12 × 3½ × ·62
1750									12 × 3½ × ·74	12 × 3½ × ·68
1920										
2100										
2290										
2480										
2690										
2910										
3160										
3460										

DECK GIRDERS at HEADS of WIDELY SPACED PILLARS, BULB ANGLE FACE BARS.

TABLE 17

(See Continuation.)

VALUES OF $\frac{S^2 \times B \times H}{100}$		DEPTH AND THICKNESS OF GIRDER.							
		Inches. 21 × ·48	Inches. 22 × ·48	Inches. 23 × ·50	Inches. 24 × ·50	Inches. 25 × ·50	Inches. 26 × ·52	Inches. 27 × ·52	Inches. 28 × ·54
190	^								
220									
260									
300									
350									
400									
460		5½ × 3 × ·36							
520		6 × 3 × ·42	5½ × 3 × ·36						
580		7 × 3 × ·46	6½ × 3 × ·42	6 × 3 × ·38	5½ × 3 × ·34				
650		8 × 3 × ·48	7½ × 3 × ·44	7 × 3 × ·42	6½ × 3 × ·40	5½ × 3 × ·36			
730		9 × 3 × ·52	8½ × 3 × ·50	8 × 3 × ·46	7½ × 3 × ·44	7 × 3 × ·40	6 × 3 × ·38	5½ × 3 × ·34	
810		10 × 3½ × ·54	9½ × 3½ × ·50	9 × 3 × ·50	8½ × 3 × ·46	7½ × 3 × ·44	7 × 3 × ·42	6½ × 3 × ·38	5½ × 3 × ·36
900		11 × 3½ × ·60	10½ × 3½ × ·56	9½ × 3½ × ·56	9½ × 3½ × ·50	8½ × 3 × ·52	8 × 3 × ·48	7½ × 3 × ·44	6½ × 3 × ·44
990	v	12 × 3½ × ·66	12 × 3½ × ·60	11 × 3½ × ·58	10½ × 3½ × ·54	9½ × 3 × ·56	9 × 3 × ·54	9 × 3 × ·48	8 × 3 × ·48
1090	^	9 × 3 × ·50	8½ × 3 × ·48	12 × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·60	10½ × 3½ × ·56	10 × 3½ × ·52	9½ × 3½ × ·50
1200		9 × 3½ × ·54	9 × 3 × ·52	9 × 3 × ·48	12 × 3½ × ·70	12 × 3½ × ·64	11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·54
1320		10½ × 3½ × ·54	9½ × 3½ × ·54	9½ × 3½ × ·50	9 × 3 × ·50	8½ × 3 × ·50	12 × 3½ × ·68	11½ × 3½ × ·66	11 × 3½ × ·62
1450		11 × 3½ × ·60	10 × 3½ × ·58	9½ × 3½ × ·56	9 × 3½ × ·54	9 × 3½ × ·52	9 × 3 × ·48	12 × 3½ × ·72	12 × 3½ × ·66
1590		11½ × 3½ × ·60	11 × 3½ × ·58	10½ × 3½ × ·56	10 × 3½ × ·54	10 × 3½ × ·50	9 × 3½ × ·52	9 × 3 × ·50	8½ × 3 × ·48
1750		12 × 3½ × ·64	11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56	10½ × 3½ × ·52	9½ × 3½ × ·54	9½ × 3½ × ·50	9 × 3 × ·52
1920		12 × 3½ × ·72	12 × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56	10½ × 3½ × ·52	9½ × 3½ × ·56
2100				12 × 3½ × ·70	12 × 3½ × ·64	11½ × 3½ × ·62	11 × 3½ × ·60	11 × 3½ × ·56	10½ × 3½ × ·62
2290					12 × 3½ × ·72	12 × 3½ × ·68	11½ × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·60
2480							12 × 3½ × ·72	12 × 3½ × ·66	11½ × 3½ × ·66
2690									12 × 3½ × ·70
2910									
3160									
3460	v								

SINGLE BULB ANGLES

DOUBLE BULB ANGLES

DECK GIRDERS at HEADS of WIDELY SPACED PILLARS, BULB ANGLE FACE BARS.

TABLE 17 *(Concluded.)*

VALUES OF $\frac{S^2 \times B \times H}{100}$		DEPTH AND THICKNESS OF GIRDER.							
		Inches. 29 × ·54	Inches. 30 × ·56	Inches. 31 × ·56	Inches. 32 × ·56	Inches. 33 × ·58	Inches. 34 × ·58	Inches. 35 × ·60	Inches. 36 × ·60
190	SINGLE BULB ANGLES								
220									
260									
300									
350									
400									
460									
520									
580									
650									
730									
810									
900		6 × 3 × ·38	5½ × 3 × ·36						
990		7½ × 3 × ·44	6½ × 3 × ·44	6 × 3 × ·40					
1090		9 × 3 × ·48	8 × 3 × ·48	7½ × 3 × ·44	7 × 3 × ·42	6½ × 3 × ·38	5½ × 3 × ·36		
1200		10 × 3½ × ·52	9 × 3 × ·54	8½ × 3 × ·52	8 × 3 × ·48	7½ × 3 × ·44	7 × 3 × ·42	6½ × 3 × ·38	5½ × 3 × ·36
1320		11 × 3½ × ·56	10 × 3½ × ·56	9½ × 3½ × ·52	9 × 3 × ·54	8½ × 3 × ·50	8 × 3 × ·46	7½ × 3 × ·44	7 × 3 × ·42
1450		11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56	9½ × 3½ × ·56	9½ × 3½ × ·50	9 × 3 × ·50	8½ × 3 × ·48	7½ × 3 × ·48
1590		12 × 3½ × ·66	12 × 3½ × ·60	11 × 3½ × ·60	11 × 3½ × ·54	10 × 3½ × ·56	10 × 3½ × ·50	9 × 3 × ·52	8½ × 3 × ·50
1750	DOUBLE BULB ANGLES	8½ × 3 × ·50	12 × 3½ × ·68	11½ × 3½ × ·66	11½ × 3½ × ·60	11 × 3½ × ·58	10½ × 3½ × ·54	9½ × 3½ × ·56	9½ × 3½ × ·50
1920		9½ × 3½ × ·48	9 × 3 × ·50	8½ × 3 × ·50	12 × 3½ × ·70	11½ × 3½ × ·66	11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56
2100		10 × 3½ × ·54	9 × 3½ × ·54	9 × 3 × ·54	9 × 3 × ·50	8½ × 3 × ·50	12 × 3½ × ·70	11½ × 3½ × ·66	11½ × 3½ × ·62
2290		11 × 3½ × ·56	10½ × 3½ × ·54	9½ × 3½ × ·56	9 × 3½ × ·54	9 × 3 × ·54	9 × 3 × ·50	8½ × 3 × ·50	12 × 3½ × ·70
2480		11½ × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·56	10½ × 3½ × ·52	9½ × 3½ × ·56	9 × 3½ × ·54	9 × 3 × ·54	9 × 3 × ·50
2690		12 × 3½ × ·66	11½ × 3½ × ·64	11 × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·58	10½ × 3½ × ·54	9½ × 3½ × ·56	9 × 3½ × ·54
2910		12 × 3½ × ·74	12 × 3½ × ·70	12 × 3½ × ·66	11½ × 3½ × ·64	11 × 3½ × ·62	11 × 3½ × ·58	10½ × 3½ × ·58	10½ × 3½ × ·54
3160				12 × 3½ × ·74	12 × 3½ × ·68	12 × 3½ × ·66	11½ × 3½ × ·64	11 × 3½ × ·62	11 × 3½ × ·58
3460							12 × 3½ × ·70	12 × 3½ × ·66	12 × 3½ × ·62

SHELL PLATING.

FULL SCANTLING VESSELS.

TABLE 18

FIRST LONGITUDINAL NUMERAL. L × D	BREADTH OF FLAT PLATE KEEL AND GARBOARD STRAKE.	THICKNESS OF FLAT KEEL PLATE.		THICKNESS OF GARBOARD STRAKE WITH BAR KEEL.		THICKNESS OF SHELL PLATING.				
						From Flat Plate Keel or Garboard Strake to Upper Turn of Bilge.		From Upper Turn of Bilge to Strake Below Sheerstrake.		Propeller Boss Plates.
		For ⅗-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
800	35	·38	·34	·30	·26	·28	·24	·28	·24	·28
1100	36	·40	·36	·32	·28	·30	·26	·30	·26	·30
1450	37	·42	·38	·34	·30	·32	·28	·32	·28	·32
1900	38	·44	·40	·38	·34	·34	·30	·34	·30	·34
2400	39	·46	·42	·40	·36	·36	·32	·36	·32	·36
2900	40	·48	·44	·42	·38	·38	·34	·38	·34	·38
3500	41	·50	·46	·44	·40	·40	·36	·40	·36	·40
4200	42	·52	·48	·48	·42	·42	·38	·42	·38	·42
4900	43	·54	·50	·50	·44	·44	·38	·44	·38	·46
5650	44	·58	·54	·52	·46	·46	·40	·46	·40	·50
6450	45	·60	·56	·54	·48	·48	·40	·48	·40	·54
7300	46	·64	·58	·56	·50	·50	·42	·50	·40	·56
8200	47	·66	·60	·58	·50	·52	·42	·52	·42	·60
9100	47	·68	·62	·60	·52	·54	·44	·54	·42	·62
10000	48	·72	·64			·56	·44	·56	·42	·64
11000	49	·74	·66			·58	·46	·58	·44	·66
12000	49	·78	·68			·60	·46	·60	·44	·70
13000	50	·80	·70			·62	·48	·62	·46	·72
14000	51	·84	·74			·64	·48	·64	·46	·74
15100	52	·86	·76			·68	·50	·66	·46	·76
16200	53	·88	·80			·70	·50	·68	·48	·78
17400	54	·92	·82			·72	·52	·70	·48	·80
18600	55	·94	·84			·74	·52	·72	·50	·82
19800	56	·98	·86			·76	·54	·74	·50	·86
21100	57	1·00	·88			·78	·56	·76	·52	·88
22400	59	1·02	·90			·82	·56	·78	·52	·90
23800	60	1·06	·94			·84	·58	·80	·54	·92
25200	61	1·10	·98			·86	·60	·82	·56	·94
26700	62	1·12	1·02			·88	·60	·84	·56	·96

SHELL PLATING.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 19

FIRST LONGITUDINAL NUMERAL. L × D	BREADTH OF FLAT PLATE KEEL AND GARBOARD STRAKE.	THICKNESS OF FLAT PLATE KEEL.		THICKNESS OF GARBOARD STRAKE WITH BAR KEEL.		THICKNESS OF SHELL PLATING.				
						From Flat Plate Keel or Garboard Strake to Upper Turn of Bilge.		From Upper Turn of Bilge to Strake Below Sheerstrake.		Propeller Boss Plates.
		For ¾-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	For ½-Length Amids.	At Ends.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3500	41	·44	·40	·40	·38	·38	·36	·38	·36	·40
4200	42	·46	·42	·42	·40	·40	·38	·40	·38	·42
4900	43	·48	·44	·44	·40	·42	·38	·42	·38	·46
5650	44	·50	·46	·46	·42	·44	·40	·44	·40	·50
6450	45	·52	·48	·48	·42	·44	·40	·44	·40	·54
7300	46	·56	·52	·50	·44	·46	·42	·46	·40	·56
8200	47	·58	·54	·52	·46	·48	·42	·48	·42	·56
9100	47	·60	·56	·54	·48	·50	·44	·50	·42	·56
10000	48	·64	·58			·52	·44	·52	·42	·60
11000	49	·66	·60			·52	·46	·52	·44	·60
12000	49	·70	·62			·54	·46	·54	·44	·62
13000	50	·72	·64			·56	·48	·56	·46	·64
14000	51	·76	·66			·58	·48	·58	·46	·66
15100	52	·78	·68			·60	·50	·60	·46	·70
16200	53	·80	·70			·62	·50	·62	·48	·72
17400	54	·84	·74			·66	·52	·64	·48	·74
18600	55	·86	·76			·68	·52	·66	·50	·76
19800	56	·90	·80			·70	·54	·68	·50	·78
21100	57	·92	·82			·72	·56	·70	·52	·80
22400	59	·94	·84			·74	·56	·72	·52	·82
23800	60	·96	·86			·76	·58	·74	·54	·86
25200	61	1·00	·88			·80	·60	·76	·56	·88
26700	62	1·02	·90			·82	·60	·78	·56	·90
28200	64	1·06	·94			·84	·62	·78	·58	·90
29800	65	1·08	·96			·86	·64	·80	·58	·92
31400	67	1·12	1·02			·88	·64	·82	·60	·94
33000	68	1·14	1·04			·90	·64	·84	·60	·96

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 10												
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.												
					UPPER DECK.										
					FLUSH DECK VESSELS.										
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheer-strake and Strake below.	Stringer Plate.	Sheer-strake.	Strake below Sheer-strake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	40		·28	·28	15 × ·30	10 × ·30							·02		
2000	40		·30	·30	15 × ·30	10 × ·30							·02		
2500	41		·30	·30	16 × ·30	10 × ·30							·02		
3000	41		·32	·32	17 × ·30	10 × ·30							·02		
3500	41		·32	·32	18 × ·32	10 × ·32							·02		
4000	42		·34	·34	19 × ·32	10 × ·32							·02		
4500	42		·34	·34	20 × ·32	10 × ·32							·02		
5000	43		·36	·36	21 × ·34	10 × ·34							·02		
5750	43		·36	·36	23 × ·34	11 × ·34							·02		
6500	44		·38	·38	25 × ·36	12 × ·36							·04		
7250	44		·38	·38	27 × ·36	13 × ·36							·06		
8000	44		·40	·40	30 × ·36	14 × ·36							·08		
9000	45		·42	·42	32 × ·38	15 × ·38							·10		
10000	45	45	·42	·42	34 × ·38	16 × ·38							·14	·30	·32
11000	45	45	·44	·44	38 × ·40	17 × ·40							·16	·30	·32
12000	46	45	·46	·44	42 × ·42	20 × ·42	42 × ·42	12 × ·42	·34				·16	·30	·32
13000	46	45	·48	·46	44 × ·44	20 × ·44	42 × ·44	14 × ·44	·34				·18	·30	·32
14000	46	45	·50	·48	48 × ·46	23 × ·46	42 × ·46	16 × ·46	·38				·18	·30	·32
15000	47	45	·50	·48	50 × ·48	25 × ·48	44 × ·46	18 × ·46	·40				·20	·30	·32
16000	47	45	·52	·50	50 × ·48	28 × ·48	45 × ·48	20 × ·48	·40				·22	·30	·34
17000	47	45	·52	·50	52 × ·50	32 × ·50	48 × ·48	23 × ·48	·40				·22	·30	·34
18000	48	45	·54	·52	55 × ·50	37 × ·50	50 × ·50	28 × ·50	·42		·40		·22	·30	·34
19000	48	45	·54	·52	55 × ·50	47 × ·50	53 × ·50	34 × ·50	·42		·40		·22	·32	·34
20000	48	46	·54	·52	·42	·30	·42	·30	·42		·40		·14	·32	·36
21000	48	47	·56	·54	·46	·30	·44	·30	·44		·42		·14	·32	·36
22000	48	48	·56	·54	·50	·32	·44	·30	·44		·42		·14	·32	·36
23000	49	49	·58	·56	·52	·34	·46	·30	·44		·42		·14	·32	·38
24000	49	50	·58	·56	·52	·36	·50	·30	·44		·44		·14	·34	·38

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.

10

THICKNESSES FOR $\frac{1}{2}$ LENGTH AMIDSHIPS.

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		UPPER DECK.												
					FLUSH DECK VESSELS.										
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
25500	49	51	·60	·58	·54	·40	·52	·34	·46		·44		·14	·34	·38
27000	49	52	·62	·60	·56	·42	·56	·36	·46	·30	·46	·30	·14	·34	·40
28500	50	53	·64	·62	·56	·46	·56	·40	·50	·30	·46	·30	·14	·36	·40
30000	50	54	·64	·62	·58	·50	·58	·44	·54	·30	·50	·30	·16	·36	·42
31500	50	55	·66	·64	·58	·54			·56	·30	·54	·30	·16	·36	·42
33000	50	56	·66	·64	·60	·58			·60	·34	·56	·32	·16	·36	·42
34500	50	57	·68	·66	·62	·62			·60	·38	·60	·34	·16	·38	·44
36000	50	58	·68	·66	·66	·64			·60	·42	·60	·36	·16	·38	·44
37500	51	59	·70	·68	·68	·68			·60	·44	·60	·38	·16	·40	·44
39000	51	60	·70	·68	·72	·72			·62	·46	·62	·40	·16	·40	·44
40500	51	61	·72	·70	·74	·74			·62	·50	·62	·42	·16	·40	·46
42000	51	62	·72	·70	·78	·78			·64	·52	·64	·44	·16	·40	·46
43500	51	63	·74	·72	·82	·82			·64	·56	·64	·48	·16	·42	·46
45000	52	64	·74	·72	·84	·84			·66	·58	·66	·50	·16	·42	·46
46500	52	65	·74	·72					·66	·62	·66	·52	·16	·42	·46
48000	52	66	·76	·74					·68	·64	·68	·54	·16	·42	·48
50000	52	68	·76	·74					·70	·68	·68	·58	·16	·44	·48
52000	53	69	·78	·76					·72	·70	·70	·60	·16	·44	·48
54000	53	70	·80	·78					·74	·74	·72	·64	·16	·44	·48
56000	53	72	·82	·80					·76	·76	·74	·66	·16	·46	·48
58000	54	74	·82	·80					·80	·80	·74	·70	·16	·46	·48
60000	54	76	·84	·82					·82	·82	·76	·74	·16	·46	·48
62000	54	77	·84	·82					·84	·84	·76	·78	·16	·48	·48
64000	55	79	·86	·84					·86	·86	·80	·80	·16	·48	·48
66000	55	80	·88	·86					·88	·88	·84	·84	·16	·48	·48
68000	56	81	·88	·86					·90	·90	·86	·86	·16	·48	·48
70000	56	83	·90	·88					·94	·94	·90	·90	·16	·50	·50

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 11 THICKNESSES FOR ½ LENGTH AMIDSHIPS.													
					UPPER DECK.											
					FLUSH DECK VESSELS.											
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheer-strake and Strake below.	Stringer Plate.	Sheer-strake.	Strake below Sheer-strake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	40		·30	·30	15×·30	10×·30							·02		
2000	40		·30	·30	16×·30	10×·30							·02		
2500	41		·32	·32	17×·32	10×·32							·02		
3000	41		·32	·32	18×·32	10×·32							·02		
3500	41		·34	·32	19×·32	10×·32							·02		
4000	42		·36	·34	20×·34	10×·34							·02		
4500	42		·36	·36	22×·34	10×·34							·02		
5000	43		·38	·38	24×·36	10×·36							·02		
5750	43		·38	·38	26×·36	11×·36							·02		
6500	44		·40	·40	28×·36	12×·36							·04		
7250	44		·40	·40	30×·36	13×·36							·06		
8000	44		·42	·42	32×·38	14×·38							·08		
9000	45		·44	·42	35×·40	15×·40							·10		
10000	45	45	·44	·42	38×·40	16×·40							·14	·30	·32
11000	45	45	·46	·44	40×·42	18×·42							·16	·30	·32
12000	46	45	·48	·46	44×·44	20×·44	42×·44	16×·44	·36				·18	·30	·32
13000	46	45	·50	·48	47×·46	20×·46	43×·44	19×·44	·36				·18	·30	·32
14000	46	45	·52	·48	50×·48	25×·48	45×·46	24×·46	·38				·20	·30	·32
15000	47	45	·52	·48	53×·48	32×·48	47×·48	26×·48	·38				·20	·30	·32
16000	47	45	·54	·50	55×·50	39×·50	50×·50	28×·50	·40				·22	·30	·32
17000	47	45	·54	·50	·44	·30	·40	·30	·40				·14	·32	·34
18000	48	45	·56	·52	·48	·30	·42	·30	·40		·40		·14	·32	·34
19000	48	46	·56	·52	·50	·34	·46	·30	·42		·40		·14	·32	·34
20000	48	46	·56	·52	·52	·36	·50	·30	·42		·40		·14	·32	·34
21000	48	47	·58	·54	·52	·38	·50	·32	·44	·30	·42	·30	·14	·32	·36
22000	48	48	·58	·54	·52	·42	·52	·34	·44	·30	·42	·30	·14	·34	·36
23000	49	49	·60	·56	·54	·44	·54	·36	·50	·30	·44	·30	·14	·34	·36
24000	49	50	·62	·58	·56	·46	·56	·38	·54	·30	·50	·30	·14	·34	·38

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 11												
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.												
					UPPER DECK.										
					FLUSH DECK VESSELS.										
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
25500	49	51	·64	·60	·58	·50	·58	·42	·56	·32	·54	·30	·14	·34	·38
27000	49	52	·66	·62	·60	·54	·60	·46	·60	·34	·60	·30	·14	·36	·38
28500	50	53	·68	·62	·60	·58	·60	·50	·60	·38	·60	·34	·14	·36	·40
30000	50	54	·68	·64	·62	·62	·62	·54	·62	·40	·62	·36	·16	·36	·40
31500	50	55	·70	·66	·66	·64			·62	·44	·62	·40	·16	·38	·42
33000	50	56	·70	·66	·68	·68			·64	·46	·64	·42	·16	·38	·42
34500	50	57	·72	·68	·72	·70			·64	·50	·64	·46	·16	·38	·42
36000	50	58	·74	·68	·74	·74			·66	·54	·66	·48	·16	·40	·44
37500	51	59	·74	·68	·76	·76			·66	·58	·66	·52	·16	·40	·44
39000	51	60	·76	·70	·80	·80			·68	·60	·68	·54	·16	·40	·44
40500	51	61	·78	·72	·82	·82			·68	·64	·68	·58	·16	·40	·44
42000	51	62	·78	·72	·86	·86			·70	·66	·70	·60	·16	·42	·46
43500	51	63	·80	·74	·88	·88			·72	·68	·70	·64	·16	·42	·46
45000	52	64	·82	·76	·92	·92			·74	·72	·72	·66	·16	·42	·46
46500	52	65	·82	·76					·76	·76	·72	·70	·16	·42	·48
48000	52	66	·84	·78					·78	·78	·74	·72	·16	·42	·48
50000	52	68	·84	·80					·82	·82	·76	·76	·16	·44	·48
52000	53	69	·86	·80					·84	·84	·78	·78	·16	·44	·48
54000	53	70	·88	·82					·86	·86	·80	·80	·16	·44	·48
56000	53	72	·90	·84					·88	·88	·82	·82	·16	·46	·48
58000	54	74	·90	·84					·90	·90	·84	·84	·16	·46	·48
60000	54	76	·92	·86					·94	·94	·86	·86	·16	·46	·48
62000	54	77	·92	·86					·96	·96	·90	·90	·18	·48	·48
64000	55	79	·94	·88					1·00	1·00	·92	·92	·18	·48	·48
66000	55	80	·96	·90					1·04	1·04	·96	·96	·18	·48	·48
68000	56	81	·96	·90					1·06	1·06	·98	·98	·18	·48	·48
70000	56	83	·98	·92					1·10	1·10	1·02	1·02	·18	·50	·50

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 12													
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.													
					UPPER DECK.											
					FLUSH DECK VESSELS.											
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	40		·30	·30	16 × ·30	10 × ·30							·02		
2000	40		·30	·30	17 × ·30	10 × ·30							·02		
2500	41		·32	·30	18 × ·32	10 × ·32							·02		
3000	41		·34	·32	19 × ·32	10 × ·32							·02		
3500	41		·34	·32	21 × ·34	10 × ·34							·02		
4000	42		·36	·34	23 × ·34	10 × ·34							·02		
4500	42		·38	·36	25 × ·36	10 × ·36							·02		
5000	43		·40	·38	27 × ·36	11 × ·36							·02		
5750	43		·40	·38	29 × ·36	12 × ·36							·02		
6500	44		·42	·40	31 × ·38	13 × ·38							·04		
7250	44		·42	·40	33 × ·38	14 × ·38							·06		
8000	44		·44	·42	36 × ·38	15 × ·38							·08		
9000	45		·46	·44	38 × ·40	16 × ·40							·10		
10000	45	45	·46	·44	40 × ·40	18 × ·40							·14	·30	·32
11000	45	45	·48	·46	42 × ·42	20 × ·42							·16	·30	·32
12000	46	45	·50	·46	44 × ·44	22 × ·44	42 × ·44	17 × ·44	·38				·18	·30	·32
13000	46	45	·52	·48	47 × ·48	22 × ·48	44 × ·44	19 × ·44	·38				·18	·30	·32
14000	46	45	·54	·50	50 × ·50	25 × ·50	46 × ·46	24 × ·46	·38				·20	·30	·32
15000	47	45	·54	·50	54 × ·50	32 × ·50	48 × ·48	26 × ·48	·40				·20	·32	·32
16000	47	45	·56	·52	58 × ·50	39 × ·50	52 × ·50	28 × ·50	·40				·22	·32	·32
17000	47	45	·56	·52	·50	·30	·42	·30	·40				·14	·32	·34
18000	48	45	·58	·54	·52	·30	·44	·30	·42		·40		·14	·34	·34
19000	48	46	·58	·54	·52	·34	·50	·30	·44		·42		·14	·34	·34
20000	48	46	·60	·56	·54	·36	·54	·30	·46	·30	·44	·30	·14	·34	·34
21000	48	47	·62	·58	·56	·38	·54	·32	·50	·30	·48	·30	·14	·34	·36
22000	48	48	·62	·58	·58	·42	·56	·36	·52	·30	·52	·30	·16	·36	·36
23000	49	49	·64	·60	·58	·46	·58	·38	·56	·30	·54	·30	·16	·36	·36
24000	49	50	·66	·60	·60	·48	·60	·42	·58	·32	·58	·32	·16	·36	·38

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 12 THICKNESSES FOR ½ LENGTH AMIDSHIPS.												
					UPPER DECK.										
					FLUSH DECK VESSELS.										
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheer-strake and Strake below.	Stringer Plate.	Sheer-strake.	Strake below Sheer-strake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
25500	49	51	·68	·62	·62	·52	·62	·46	·60	·36	·58	·36	·18	·38	·38
27000	49	52	·70	·64	·64	·56	·64	·52	·62	·40	·60	·38	·18	·38	·38
28500	50	53	·72	·64	·64	·60	·64	·58	·62	·44	·60	·42	·18	·38	·40
30000	50	54	·72	·66	·66	·66	·64	·62	·64	·46	·62	·44	·18	·38	·40
31500	50	55	·74	·68	·70	·70			·66	·48	·64	·46	·20	·40	·42
33000	50	56	·76	·68	·74	·72			·68	·50	·68	·46	·20	·40	·42
34500	50	57	·78	·70	·76	·76			·70	·54	·70	·50	·20	·40	·42
36000	50	58	·80	·72	·78	·78			·70	·58	·70	·54	·20	·40	·44
37500	51	59	·80	·72	·82	·82			·72	·60	·72	·58	·20	·42	·44
39000	51	60	·82	·74	·86	·86			·72	·64	·72	·60	·20	·42	·44
40500	51	61	·84	·76					·74	·66	·74	·62	·20	·42	·44
42000	51	62	·86	·76					·74	·70	·74	·66	·20	·42	·46
43500	51	63	·88	·78					·76	·72	·76	·68	·20	·44	·46
45000	52	64	·90	·80					·78	·76	·78	·70	·20	·44	·46
46500	52	65	·90	·80					·80	·78	·80	·72	·20	·44	·48
48000	52	66	·92	·82					·80	·80	·80	·74	·20	·44	·48
50000	52	68	·92	·84					·84	·84	·82	·78	·20	·46	·48
52000	53	69	·94	·84					·86	·86	·82	·82	·20	·46	·48
54000	53	70	·96	·86					·90	·90	·84	·84	·20	·46	·48
56000	53	72	·98	·88					·94	·94	·86	·86	·20	·46	·48
58000	54	74	·98	·88					·98	·96	·90	·90	·20	·46	·48
60000	54	76	1·00	·90					1·00	1·00	·94	·94	·20	·48	·48
62000	54	77	1·00	·90					1·04	1·04	·98	·98	·20	·48	·48
64000	55	79	1·02	·92					1·10	1·10	1·00	1·00	·20	·48	·48
66000	55	80	1·04	·94					1·14	1·14	1·04	1·04	·20	·50	·50
68000	56	81	1·04	·94					1·18	1·18	1·08	1·08	·20	·50	·50
70000	56	83	1·06	·96					1·22	1·22	1·12	1·12	·20	·50	·50

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 13 THICKNESSES FOR ½ LENGTH AMIDSHIPS. UPPER DECK.													
					FLUSH DECK VESSELS.								Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.					
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.					
	Sheer-strake and Strake below.	Stringer Plate.	Sheer-strake.	Strake below Sheer-strake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	40		·32	·32	19×·30	10×·30							·02		
2000	40		·34	·32	20×·32	10×·32							·02		
2500	41		·34	·32	22×·32	10×·32							·02		
3000	41		·36	·34	24×·34	10×·34							·02		
3500	41		·36	·34	24×·34	10×·34							·02		
4000	42		·38	·36	26×·36	10×·36							·02		
4500	42		·40	·36	28×·36	10×·36							·02		
5000	43		·42	·38	30×·38	11×·38							·02		
5750	43		·42	·38	32×·38	12×·38							·02		
6500	44		·44	·40	34×·40	13×·40							·04		
7250	44		·44	·42	36×·40	14×·40							·06		
8000	44		·46	·44	39×·40	15×·40							·08		
9000	45		·48	·44	41×·42	16×·42							·10		
10000	45	45	·50	·46	43×·44	18×·44							·14	·30	·32
11000	45	45	·52	·48	43×·46	20×·46							·16	·30	·32
12000	46	45	·54	·48	46×·46	22×·46	42×·44	18×·44	·40				·18	·30	·32
13000	46	45	·56	·50	48×·48	23×·48	44×·44	21×·44	·40				·18	·30	·32
14000	46	45	·58	·50	50×·50	30×·50	46×·46	25×·46	·42				·20	·30	·32
15000	47	45	·60	·52	54×·50	33×·50	49×·48	29×·48	·42				·20	·32	·32
16000	47	45	·62	·54	·46	·30	·42	·30	·42				·14	·32	·32
17000	47	45	·62	·56	·50	·30	·46	·30	·44				·14	·34	·34
18000	48	45	·64	·56	·52	·32	·48	·30	·44	·30	·42		·14	·34	·34
19000	48	46	·66	·58	·56	·34	·54	·30	·46	·30	·44		·14	·34	·34
20000	48	46	·68	·58	·60	·36	·58	·32	·50	·30	·48	·30	·16	·36	·36
21000	48	47	·70	·60	·62	·38	·60	·34	·54	·30	·52	·30	·16	·36	·36
22000	48	48	·72	·62	·62	·42	·62	·36	·58	·30	·58	·30	·16	·38	·38
23000	49	49	·74	·64	·64	·46	·64	·38	·62	·32	·60	·32	·18	·38	·38
24000	49	50	·76	·66	·66	·48	·66	·40	·62	·36	·64	·34	·18	·38	·38

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 13												
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.												
					UPPER DECK.										
					FLUSH DECK VESSELS.										
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.		Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.				
	Sheer-strake and Strake below.	Stringer Plate.	Sheer-strake.	Strake below Sheer-strake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.			
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
25500	49	51	·78	·66	·68	·52	·68	·46	·66	·38	·64	·36	·20	·38	·38
27000	49	52	·80	·68	·70	·56	·70	·52	·68	·40	·68	·38	·20	·40	·40
28500	50	53	·82	·68	·72	·60	·70	·58	·68	·44	·70	·42	·20	·40	·40
30000	50	54	·84	·72	·72	·66	·72	·62	·72	·46	·72	·44	·22	·40	·40
31500	50	55	·86	·74	·76	·70			·74	·50	·74	·46	·22	·42	·42
33000	50	56	·88	·74	·78	·74			·76	·54	·76	·50	·22	·42	·42
34500	50	57	·90	·76	·80	·78			·78	·58	·78	·54	·22	·42	·42
36000	50	58	·92	·78	·82	·80			·80	·62	·78	·58	·24	·42	·42
37500	51	59	·92	·80					·80	·64	·80	·62	·24	·44	·44
39000	51	60	·94	·82					·84	·68	·84	·64	·24	·44	·44
40500	51	61	·96	·82					·84	·70	·84	·66	·24	·44	·44
42000	51	62	·98	·82					·86	·72	·86	·68	·24	·46	·46
43500	51	63	1·00	·84					·88	·76	·88	·72	·24	·46	·46
45000	52	64	1·02	·86					·90	·80	·90	·74	·24	·46	·46
46500	52	65	1·02	·88					·92	·82	·92	·76	·24	·46	·46
48000	52	66	1·04	·90					·92	·84	·92	·80	·24	·48	·48
50000	52	68	1·06	·92					·96	·88	·94	·82	·24	·48	·48
52000	53	69	1·08	·92					·98	·92	·96	·84	·24	·48	·48
54000	53	70	1·10	·94					1·00	·96	·98	·88	·24	·48	·48
56000	53	72	1·12	·96					1·02	1·00	1·00	·92	·24	·48	·48
58000	54	74	1·14	·96					1·04	1·04	1·02	·96	·24	·50	·50
60000	54	76	1·16	·98					1·08	1·08	1·06	1·00	·24	·50	·50
62000	54	77	1·16	1·00					1·12	1·12	1·10	1·04	·24	·50	·50
64000	55	79	1·18	1·02					1·16	1·16	1·14	1·08	·24	·50	·50
66000	55	80	1·20	1·04					1·20	1·20	1·18	1·12	·24	·50	·50
68000	56	81	1·22	1·06							1·22	1·16	·24	·50	·50
70000															

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. $13\frac{1}{2}$

THICKNESSES FOR $\frac{1}{2}$ LENGTH AMIDSHIPS.

SECOND LONGITUDINAL NUMERAL $L \times (B+D)$	BREADTH OF		UPPER DECK.													THICKNESSES AT ENDS.	
					FLUSH DECK VESSELS.								Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings		
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.						
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.						
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating				Stringer Plates at Ends of Upper Deck, also Thickness of Tie Plates at Ends.	Thickness of Upper Deck Plating at Ends.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	40		·34	·32	20×·30	10×·30							·02			12×·24	
2000	40		·36	·32	22×·32	10×·32							·02			12×·24	
2500	41		·36	·32	24×·32	10×·32							·02			13×·24	
3000	41		·38	·34	26×·34	10×·34							·02			14×·24	
3500	41		·38	·34	26×·34	10×·34							·02			15×·26	
4000	42		·40	·36	28×·36	10×·36							·02			16×·26	
4500	42		·40	·36	30×·36	10×·36							·02			17×·28	
5000	43		·42	·38	32×·38	11×·38							·02			18×·28	
5750	43		·42	·38	34×·38	12×·38							·02			20×·30	
6500	44		·44	·40	36×·40	13×·40							·04			21×·32	
7250	44		·46	·42	38×·40	14×·40							·06			23×·32	
8000	44		·48	·44	40×·42	15×·42							·08			25×·34	
9000	45		·50	·44	42×·44	16×·44							·10			26×·34	
10000	45	45	·52	·46	44×·46	18×·46							·14	·30	·32	27×·34	·30
11000	45	45	·54	·48	44×·48	20×·48							·16	·30	·32	28×·34	·30
12000	46	45	·56	·50	46×·48	22×·48	42×·44	18×·44	·40				·18	·30	·32	29×·34	·30
13000	46	45	·58	·50	48×·48	24×·48	44×·44	21×·44	·40				·18	·30	·32	30×·34	·30
14000	46	45	·60	·52	50×·50	27×·50	46×·46	25×·46	·42				·20	·30	·32	31×·34	·30
15000	47	45	·62	·54	55×·50	34×·50	50×·48	30×·48	·42				·20	·32	·32	32×·36	·30
16000	47	45	·64	·56	·46	·30	·42	·30	·42				·14	·32	·32	33×·36	·30
17000	47	45	·66	·58	·52	·30	·46	·30	·44				·14	·34	·34	33×·36	·30
18000	48	45	·68	·58	·54	·32	·50	·30	·44	·30	·42		·14	·34	·34	34×·36	·30
19000	48	46	·70	·60	·58	·34	·56	·30	·46	·30	·44		·14	·34	·34	34×·38	·30
20000	48	46	·72	·60	·62	·36	·60	·32	·52	·30	·50	·30	·16	·36	·36	35×·38	·30
21000	48	47	·74	·62	·64	·38	·62	·34	·56	·30	·54	·30	·16	·36	·36	35×·38	·30
22000	48	48	·76	·64	·64	·42	·64	·36	·62	·30	·60	·30	·16	·38	·38	35×·38	·30
23000	49	49	·78	·66	·66	·46	·66	·40	·64	·32	·62	·32	·18	·38	·38	36×·38	·30
24000	49	50	·80	·68	·68	·48	·68	·42	·66	·36	·66	·34	·18	·38	·38	36×·38	·32

The thicknesses of the Sheerstrake and of the Strake below the Sheerstrake at the ends of the vessel may be the same as the thickness of the side plating at the ends of the vessel.

TOPSIDE SCANTLINGS.

FULL SCANTLING VESSELS.

TABLE 20 *(Concluded.)*

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 13½												THICKNESSES AT ENDS.	
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.													
					UPPER DECK.											
					FLUSH DECK VESSELS.								Increase to Stringer Plate, Deck Plating and Tie Plates for Vessels having 100 per Cent. Superstructures.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings		
					When One Deck is Fitted.		When Two Decks are Fitted.				When Three Decks are Fitted.						
							2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.						
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating	Stringer Plate.	Deck Plating.				Stringer Plates at Ends of Upper Deck, also Thickness of Tie Plates at Ends.	Thickness of Upper Deck Plating at Ends.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
25500	49	51	·82	·68	·7C	·52	·70	·48	·68	·38	·68	·36	·20	·38	·38	36 × ·40	·32
27000	49	52	·84	·70	·72	·56	·72	·52	·72	·40	·72	·38	·20	·40	·40	37 × ·40	·32
28500	50	53	·86	·72	·74	·60	·74	·58	·72	·44	·72	·42	·20	·40	·40	37 × ·40	·32
30000	50	54	·88	·74	·76	·66	·76	·62	·76	·46	·76	·44	·22	·40	·40	37 × ·40	·34
31500	50	55	·90	·76	·78	·70			·78	·50	·78	·46	·22	·42	·42	38 × ·40	·34
33000	50	56	·92	·76	·80	·74			·80	·54	·80	·50	·22	·42	·42	38 × ·42	·34
34500	50	57	·94	·78	·82	·78			·82	·58	·82	·54	·22	·42	·42	38 × ·42	·34
36000	50	58	·96	·80	·84	·82			·84	·62	·84	·58	·24	·42	·42	39 × ·42	·36
37500	51	59	·98	·82					·84	·66	·84	·62	·24	·44	·44	39 × ·42	·36
39000	51	60	1·00	·84					·88	·68	·88	·64	·24	·44	·44	39 × ·42	·36
40500	51	61	1·00	·84					·88	·72	·88	·68	·24	·44	·44	40 × ·44	·36
42000	51	62	1·02	·86					·90	·74	·90	·70	·24	·46	·46	40 × ·44	·36
43500	51	63	1·04	·88					·92	·78	·92	·72	·24	·46	·46	40 × ·44	·36
45000	52	64	1·06	·90					·94	·82	·94	·76	·24	·46	·46	41 × ·44	·36
46500	52	65	1·08	·92					·96	·84	·96	·78	·24	·46	·46	41 × ·44	·36
48000	52	66	1·10	·92					·98	·86	·98	·82	·24	·48	·48	41 × ·44	·36
50000	52	68	1·12	·94					1·00	·90	1·00	·84	·24	·48	·48	42 × ·46	·36
52000	53	69	1·14	·94					1·02	·94	1·02	·86	·24	·48	·48	42 × ·46	·36
54000	53	70	1·16	·96					1·04	·98	1·04	·88	·24	·48	·48	42 × ·46	·38
56000	53	72	1·18	·98					1·06	1·02	1·06	·94	·24	·48	·48	43 × ·46	·38
58000	54	74	1·20	1·00					1·08	1·08	1·08	·98	·24	·50	·50	43 × ·46	·38
60000	54	76	1·22	1·02					1·12	1·12	1·10	1·02	·24	·50	·50	43 × ·46	·38
62000																44 × ·46	·38
64000																44 × ·48	·38
66000																44 × ·48	·38
68000																45 × ·48	·38
70000																45 × ·48	·38

The thicknesses of the Sheerstrake and of the Strake below the Sheerstrake at the ends of the vessel may be the same as the thickness of the side plating at the ends of the vessel.

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 10									
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	46	45	·40	·40	42×·42	12×·42	·34				·30	·32
13000	46	45	·42	·42	42×·42	12×·42	·36				·30	·32
14000	46	45	·44	·44	43×·42	12×·42	·38				·30	·32
15000	47	45	·46	·46	43×·42	13×·42	·40				·30	·32
16000	47	45	·46	·46	44×·42	14×·42	·40				·30	·34
17000	47	45	·48	·48	45×·44	15×·44	·40				·30	·34
18000	48	45	·48	·48	46×·44	18×·44	·42		·38		·30	·34
19000	48	46	·50	·50	46×·46	25×·46	·42		·40		·30	·34
20000	48	46	·50	·50	50×·48	27×·48	·42		·40		·30	·36
21000	48	47	·52	·52	53×·48	32×·48	·44		·42		·30	·36
22000	48	48	·52	·52	55×·50	35×·50	·44		·42		·32	·36
23000	49	49	·54	·54	57×·50	40×·50	·44		·42		·32	·38
24000	49	50	·56	·56	60×·50	45×·50	·44		·44		·32	·38
25500	49	51	·58	·58	·48	·32	·46		·44		·32	·38
27000	49	52	·58	·58	·50	·34	·46		·46		·34	·40
28500	50	53	·60	·60	·52	·38	·48		·46		·34	·40
30000	50	54	·62	·60	·54	·40	·48		·48		·34	·42
31500	50	55	·62	·60	·56	·44	·50	·36	·50		·36	·42
33000	50	56	·64	·62	·58	·46	·50	·38	·50		·36	·42
34500	50	57	·64	·62	·58	·50	·52	·38	·52		·36	·44
36000	50	58	·64	·62	·58	·54	·54	·40	·52	·36	·36	·44
37500	51	59	·66	·64			·56	·42	·52	·38	·38	·44
39000	51	60	·66	·64			·56	·44	·54	·38	·38	·44
40500	51	61	·68	·66			·58	·46	·56	·40	·40	·46

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL.	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 10									
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.			
L×(B+D)	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	51	62	·68	·66			·60	·48	·58	·40	·40	·46
43500	51	63	·70	·68			·62	·52	·60	·42	·42	·46
45000	52	64	·72	·70			·64	·54	·62	·44	·42	·48
46500	52	65	·74	·72			·66	·56	·64	·46	·42	·48
48000	52	66	·74	·72			·68	·58	·66	·50	·42	·48
50000	52	68	·76	·74			·70	·62	·68	·54	·44	·48
52000	53	69	·76	·74			·70	·66	·68	·56	·44	·48
54000	53	70	·78	·76			·72	·70	·70	·60	·44	·48
56000	53	72	·78	·76			·74	·74	·70	·62	·46	·48
58000	54	74	·80	·78			·78	·78	·72	·66	·46	·48
60000	54	76	·80	·78			·82	·82	·74	·70	·46	·48
62000	54	77	·82	·80			·84	·84	·76	·74	·48	·48
64000	55	79	·82	·80			·86	·86	·78	·76	·48	·48
66000	55	80	·82	·80			·90	·90	·80	·80	·48	·48
68000	56	81	·82	·80			·92	·92	·84	·84	·48	·48
70000	56	82	·84	·82			·96	·96	·86	·86	·50	·50
72000	56	84	·86	·84			1·00	1·00	·90	·90	·50	·50
74500	56	86	·86	·84			1·04	1·04	·92	·92	·50	·50
77000	57	88	·88	·86			1·08	1·08	·96	·96	·52	·52
79500	57	90	·90	·88			1·12	1·12	1·00	1·00	·52	·52
82000	58	92	·92	·90			1·16	1·16	1·04	1·04	·52	·52
84500	59	94	·94	·92			1·20	1·20	1·08	1·08	·54	·54
87000	60	96	·94	·92					1·12	1·12	·54	·54

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.

11

THICKNESSES FOR ½ LENGTH AMIDSHIPS.

SECOND LONGITUDINAL NUMERAL. L × (B + D)	BREADTH OF		Sheerstrake.	Strake below Sheerstrake.	UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.			
	Sheerstrake and Strake below.	Stringer Plate.			Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	46	45	·42	·42	42 × ·42	12 × ·42	·36				·30	·32
13000	46	45	·44	·44	42 × ·42	12 × ·42	·36				·30	·32
14000	46	45	·46	·46	43 × ·42	12 × ·42	·38				·30	·32
15000	47	45	·46	·46	43 × ·42	13 × ·42	·38				·30	·32
16000	47	45	·48	·48	44 × ·44	14 × ·44	·40				·30	·32
17000	47	45	·48	·48	45 × ·44	15 × ·44	·40				·30	·34
18000	48	45	·50	·50	46 × ·46	18 × ·46	·40		·38		·30	·34
19000	48	46	·50	·50	47 × ·46	25 × ·46	·42		·40		·30	·34
20000	48	46	·52	·50	51 × ·48	27 × ·48	·42		·40		·30	·34
21000	48	47	·52	·52	54 × ·48	32 × ·48	·44		·42		·30	·36
22000	48	48	·54	·52	57 × ·50	35 × ·50	·44		·42		·32	·36
23000	49	49	·56	·54	60 × ·50	40 × ·50	·46		·44		·32	·36
24000	49	50	·58	·56	·48	·32	·48		·44		·32	·38
25500	49	51	·60	·58	·50	·34	·50		·46		·34	·38
27000	49	52	·60	·58	·50	·36	·50		·48		·34	·38
28500	50	53	·62	·60	·52	·38	·52		·48		·34	·40
30000	50	54	·62	·60	·54	·40	·52	·36	·50		·36	·40
31500	50	55	·64	·60	·56	·46	·52	·38	·52		·36	·42
33000	50	56	·64	·62	·58	·50	·54	·42	·54		·36	·42
34500	50	57	·66	·62	·60	·52	·56	·44	·56		·38	·42
36000	50	58	·66	·62	·62	·56	·56	·48	·56	·38	·38	·44
37500	51	59	·68	·64			·58	·50	·58	·42	·38	·44
39000	51	60	·68	·64			·60	·54	·60	·44	·40	·44
40500	51	61	·70	·66			·62	·56	·62	·46	·40	·44

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 11									
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	51	62	·70	·66			·64	·58	·62	·50	·40	·46
43500	51	63	·72	·68			·64	·62	·64	·52	·42	·46
45000	52	64	·74	·70			·66	·64	·66	·54	·42	·46
46500	52	65	·76	·72			·70	·64	·66	·58	·42	·48
48000	52	66	·78	·74			·72	·66	·68	·62	·42	·48
50000	52	68	·80	·76			·74	·70	·70	·66	·44	·48
52000	53	69	·80	·76			·76	·74	·72	·70	·44	·48
54000	53	70	·82	·78			·78	·78	·76	·74	·44	·48
56000	53	72	·82	·78			·82	·82	·78	·76	·46	·48
58000	54	74	·84	·80			·84	·84	·80	·80	·46	·48
60000	54	76	·84	·80			·88	·88	·82	·82	·46	·48
62000	54	77	·86	·82			·92	·92	·86	·86	·48	·48
64000	55	79	·86	·82			·94	·94	·88	·88	·48	·48
66000	55	80	·88	·84			·98	·98	·92	·92	·48	·48
68000	56	81	·88	·84			1·02	1·02	·96	·96	·48	·48
70000	56	82	·90	·86			1·06	1·06	·98	·98	·50	·50
72000	56	84	·92	·88			1·10	1·10	1·00	1·00	·50	·50
74500	56	86	·92	·88			1·14	1·14	1·04	1·04	·50	·50
77000	57	88	·94	·88			1·18	1·18	1·08	1·08	·52	·52
79500	57	90	·96	·90					1·12	1·12	·52	·52
82000	58	92	·98	·92					1·16	1·16	·52	·52
84500	59	94	1·00	·94					1·20	1·20	·54	·54
87000	60	96	1·02	·96								

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.

12

THICKNESSES FOR ½ LENGTH AMIDSHIPS.

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		UPPER DECK.									
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	46	45	·44	·44	42×·42	12×·42	·38				·30	·32
13000	46	45	·46	·44	42×·42	12×·42	·38				·30	·32
14000	46	45	·46	·46	43×·42	12×·42	·38				·30	·32
15000	47	45	·48	·46	43×·44	13×·44	·38				·30	·32
16000	47	45	·50	·48	44×·46	14×·46	·40				·30	·32
17000	47	45	·50	·48	45×·46	15×·46	·40				·30	·34
18000	48	45	·52	·50	46×·48	18×·48	·40		·38		·30	·34
19000	48	46	·54	·52	48×·50	25×·50	·42		·40		·30	·34
20000	48	46	·56	·52	51×·50	28×·50	·42		·40		·30	·34
21000	48	47	·56	·54	55×·50	32×·50	·44		·42		·30	·36
22000	48	48	·58	·54	60×·50	35×·50	·44		·42		·32	·36
23000	49	49	·58	·56	·46	·32	·46		·44		·32	·36
24000	49	50	·60	·58	·48	·34	·48		·44		·34	·38
25500	49	51	·62	·58	·52	·36	·50		·46		·34	·38
27000	49	52	·62	·58	·56	·40	·50		·48		·36	·38
28500	50	53	·64	·60	·56	·44	·54		·50		·36	·40
30000	50	54	·64	·60	·58	·48	·58	·36	·54	·36	·36	·40
31500	50	55	·66	·62	·58	·52	·58	·40	·56	·38	·38	·42
33000	50	56	·66	·62	·60	·56	·60	·44	·58	·40	·38	·42
34500	50	57	·68	·64	·64	·62	·60	·46	·60	·42	·38	·42
36000	50	58	·68	·66	·66	·66	·62	·50	·62	·46	·38	·44
37500	51	59	·70	·66			·62	·54	·62	·50	·40	·44
39000	51	60	·70	·66			·64	·58	·64	·52	·40	·44
40500	51	61	·72	·68			·66	·62	·66	·56	·42	·44

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 12									
			THICKNESSES FOR ½ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	51	62	·72	·68			·68	·66	·68	·60	·42	·46
43500	51	63	·74	·70			·70	·70	·70	·62	·42	·46
45000	52	64	·76	·72			·72	·72	·72	·64	·42	·46
46500	52	65	·78	·74			·76	·76	·74	·68	·44	·48
48000	52	66	·80	·76			·78	·78	·76	·70	·44	·48
50000	52	68	·82	·78			·82	·82	·78	·74	·44	·48
52000	53	69	·84	·78			·84	·84	·78	·78	·44	·48
54000	53	70	·86	·80			·88	·88	·82	·82	·46	·48
56000	53	72	·88	·82			·90	·90	·84	·84	·46	·48
58000	54	74	·90	·82			·94	·94	·88	·88	·46	·48
60000	54	76	·92	·84			·98	·98	·92	·92	·48	·48
62000	54	77	·92	·84			1·04	1·04	·96	·96	·48	·48
64000	55	79	·94	·86			1·08	1·08	1·00	1·00	·48	·48
66000	55	80	·96	·88			1·12	1·12	1·04	1·04	·48	·48
68000	56	81	·98	·90			1·16	1·16	1·06	1·06	·48	·48
70000	56	82	·98	·90			1·20	1·20	1·10	1·10	·50	·50
72000	56	84	1·00	·92					1·12	1·12	·50	·50
74500	56	86	1·00	·92					1·16	1·16	·50	·50
77000	57	88	1·02	·94					1·20	1·20	·52	·52
79500	57	90	1·04	·96								
82000	58	92	1·06	·96								
84500	59	94	1·08	·98								
87000	60	96	1·12	1·00								

TOPSIDE SCANTLINGS.
COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.

13

SECOND LONGITUDINAL NUMERAL. L×(B+D)	BREADTH OF		THICKNESSES FOR ½ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.			
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	46	45	·46	·44	42×·44	12×·44	·40				·30	·32
13000	46	45	·48	·44	43×·44	12×·44	·40				·30	·32
14000	46	45	·50	·46	43×·46	12×·46	·40				·30	·32
15000	47	45	·50	·46	44×·46	13×·46	·42				·30	·32
16000	47	45	·52	·48	44×·48	14×·48	·42				·30	·32
17000	47	45	·52	·48	46×·48	15×·48	·42				·30	·32
18000	48	45	·54	·50	46×·50	18×·50	·42				·30	·34
19000	48	46	·56	·52	50×·50	25×·50	·44		·40		·30	·34
20000	48	46	·58	·52	52×·50	29×·50	·44		·40		·30	·34
21000	48	47	·58	·54	55×·50	33×·50	·46		·42		·30	·34
22000	48	48	·60	·54	·44	·32	·46		·42		·32	·36
23000	49	49	·60	·56	·48	·32	·48		·44		·32	·36
24000	49	50	·62	·58	·50	·34	·50		·46		·34	·36
25500	49	51	·64	·58	·52	·38	·52		·46		·34	·38
27000	49	52	·66	·60	·56	·42	·54		·48		·36	·38
28500	50	53	·68	·62	·56	·46	·54	·36	·52		·36	·38
30000	50	54	·68	·62	·58	·48	·58	·38	·56	·36	·36	·40
31500	50	55	·70	·64	·58	·54	·58	·42	·56	·40	·38	·40
33000	50	56	·70	·64	·60	·60	·60	·46	·58	·44	·38	·42
34500	50	57	·72	·66	·64	·64	·62	·48	·60	·46	·38	·42
36000	50	58	·72	·68	·68	·68	·64	·50	·64	·48	·40	·42
37500	51	59	·74	·68			·66	·54	·66	·52	·40	·44
39000	51	60	·76	·70			·68	·58	·68	·54	·40	·44
40500	51	61	·78	·70			·70	·62	·70	·58	·42	·44

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. $L \times (B+D)$	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. 13 THICKNESSES FOR $\frac{1}{2}$ LENGTH AMIDSHIPS.									
					UPPER DECK.							
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.			
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.		Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	51	62	·80	·72			·72	·66	·72	·60	·42	·44
43500	51	63	·82	·74			·74	·70	·74	·64	·42	·46
45000	52	64	·84	·76			·76	·72	·76	·68	·42	·46
46500	52	65	·86	·78			·78	·76	·78	·70	·44	·46
48000	52	66	·88	·78			·82	·78	·82	·72	·44	·48
50000	52	68	·90	·80			·84	·84	·84	·76	·44	·48
52000	53	69	·92	·82			·88	·88	·86	·80	·44	·48
54000	53	70	·94	·84			·92	·92	·86	·86	·46	·48
56000	53	72	·96	·86			·94	·94	·88	·88	·46	·48
58000	54	74	·98	·86			·98	·98	·92	·92	·46	·48
60000	54	76	1·00	·88			1·02	1·02	·96	·96	·48	·48
62000	54	77	1·02	·88			1·06	1·06	1·00	1·00	·48	·48
64000	55	79	1·04	·90			1·10	1·10	1·04	1·04	·48	·48
66000	55	80	1·06	·92			1·14	1·14	1·08	1·08	·50	·50
68000	56	81	1·08	·94			1·18	1·18	1·12	1·12	·50	·50
70000	56	82	1·10	·96			1·22	1·22	1·16	1·16	·50	·50
72000	56	84	1·12	·98					1·20	1·20	·50	·50
74500	56	86	1·14	1·00								
77000	57	88	1·16	1·00								
79500	57	90	1·18	1·02								
82000	58	92	1·20	1·04								
84500												
87000												

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21

(See Continuation.)

SECOND LONGITUDINAL NUMERAL.	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. $13\frac{1}{2}$										THICKNESSES AT ENDS.	
			THICKNESSES FOR $\frac{1}{2}$ LENGTH AMIDSHIPS.											
					UPPER DECK.									
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.					
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.					
$L \times (B+D)$	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Tie Plates and Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings	Stringer Plates at Ends of Upper Deck; also thickness of Tie Plates at Ends.	Thickness of Upper Deck Plating at Ends.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	46	45	·46	·44	42×·44	12×·44	·40				·30	·32	29×·34	·30
13000	46	45	·48	·44	43×·44	12×·44	·40				·30	·32	30×·34	·30
14000	46	45	·50	·46	44×·46	12×·46	·40				·30	·32	31×·34	·30
15000	47	45	·50	·46	44×·46	13×·46	·42				·30	·32	32×·36	·30
16000	47	45	·52	·48	45×·48	14×·48	·42				·30	·32	33×·36	·30
17000	47	45	·52	·48	46×·50	15×·50	·42				·30	·32	33×·36	·30
18000	48	45	·54	·50	47×·50	18×·50	·42				·30	·34	34×·36	·30
19000	48	46	·56	·52	50×·50	25×·50	·44		·40		·30	·34	34×·38	·30
20000	48	46	·58	·52	52×·50	29×·50	·44		·40		·30	·34	35×·38	·30
21000	48	47	·58	·54	55×·50	33×·50	·46		·42		·30	·34	35×·38	·30
22000	48	48	·60	·54	·44	·32	·46		·42		·32	·36	35×·38	·30
23000	49	49	·60	·56	·48	·32	·48		·44		·32	·36	36×·38	·30
24000	49	50	·62	·58	·50	·34	·50		·46		·34	·36	36×·38	·32
25500	49	51	·64	·58	·54	·38	·52		·46		·34	·38	36×·40	·32
27000	49	52	·66	·60	·56	·42	·54		·48		·36	·38	37×·40	·32
28500	50	53	·68	·62	·56	·46	·54	·36	·52		·36	·38	37×·40	·32
30000	50	54	·68	·62	·58	·48	·58	·38	·56	·36	·36	·40	37×·40	·34
31500	50	55	·70	·64	·58	·54	·58	·42	·58	·40	·38	·40	38×·40	·34
33000	50	56	·70	·64	·60	·60	·60	·46	·60	·44	·38	·42	38×·42	·34
34500	50	57	·72	·66	·64	·64	·64	·48	·62	·46	·38	·42	38×·42	·34
36000	50	58	·74	·68	·68	·68	·66	·50	·66	·48	·40	·42	39×·42	·36
37500	51	59	·76	·68			·68	·54	·68	·52	·40	·44	39×·42	·36
39000	51	60	·78	·70			·70	·58	·70	·54	·40	·44	39×·42	·36
40500	51	61	·80	·70			·72	·62	·72	·58	·42	·44	40×·44	·36

The Thicknesses of the Sheerstrake and of the Strake below the Sheerstrake at the ends of the vessel may be the same as the thickness of the side plating at the ends of the vessel.

TOPSIDE SCANTLINGS.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 21 *(Concluded.)*

SECOND LONGITUDINAL NUMERAL.	BREADTH OF		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK. $13\frac{1}{2}$										THICKNESSES AT ENDS.	
			THICKNESSES FOR $\frac{1}{2}$ LENGTH AMIDSHIPS.											
					UPPER DECK.									
					When Two Decks are Fitted.				When Three Steel Decks are Fitted.					
					2nd Deck of Stringers and Tie Plates.		2nd Deck of Steel.		2nd and 3rd Decks of Steel.					
$L \times (B+D)$	Sheerstrake and Strake below.	Stringer Plate.	Sheerstrake.	Strake below Sheerstrake.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings	Stringer Plates at Ends of Upper Deck; also thickness of Tie Plates at Ends.	Thickness of Upper Deck Plating at Ends.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	51	62	·82	·72			·74	·66	·74	·60	·42	·44	40 × ·44	·36
43500	51	63	·84	·74			·76	·70	·76	·64	·42	·46	40 × ·44	·36
45000	52	64	·86	·76			·78	·72	·78	·68	·42	·46	41 × ·44	·36
46500	52	65	·88	·78			·80	·76	·80	·70	·44	·46	41 × ·44	·36
48000	52	66	·90	·78			·84	·78	·84	·72	·44	·48	41 × ·44	·36
50000	52	68	·92	·80			·86	·84	·84	·78	·44	·48	42 × ·46	·36
52000	53	69	·94	·82			·88	·88	·86	·82	·44	·48	42 × ·46	·36
54000	53	70	·96	·84			·92	·92	·88	·86	·46	·48	42 × ·46	·38
56000	53	72	·98	·86			·96	·96	·90	·90	·46	·48	43 × ·46	·38
58000	54	74	1·00	·88			1·00	1·00	·94	·94	·46	·48	43 × ·46	·38
60000	54	76	1·02	·90			1·04	1·04	·98	·98	·48	·48	43 × ·46	·38
62000	54	77	1·06	·90			1·08	1·08	1·02	1·02	·48	·48	44 × ·46	·38
64000	55	79	1·08	·92			1·12	1·12	1·06	1·06	·48	·48	44 × ·48	·38
66000	55	80	1·10	·94			1·16	1·16	1·10	1·10	·50	·50	44 × ·48	·38
68000	56	81	1·12	·96			1·20	1·20	1·14	1·14	·50	·50	45 × ·48	·38
70000	56	82	1·14	·98					1·18	1·18	·50	·50	45 × ·48	·38
72000	56	84	1·16	1·00									45 × ·50	·40
74500	56	86	1·18	1·02									46 × ·50	·40
77000	57	88	1·20	1·04									46 × ·50	·40
79500	57	90	1·22	1·06									47 × ·50	·40
82000													47 × ·50	·40
84500													48 × ·50	·40
87000													48 × ·50	·40

The Thicknesses of the Sheerstrake and of the Strake below the Sheerstrake at the ends of the vessel may be the same as the thickness of the side plating at the ends of the vessel.

PARTIAL SUPERSTRUCTURES.

FULL SCANTLING VESSELS.

TABLE 22

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L×(B+D)	PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. THICKNESS OF BRIDGE SIDE PLATING.			BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 10										Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES.											
	40	60	80		40				60				80			
					THICKNESS OF "LONG" BRIDGE DECK.											
					When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.			
					Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	·40	·42	·44	45	42×·36	12×·36			42×·38	12×·38			42×·40	12×·40			·30	·32
13000	·40	·42	·44	45	42×·36	13×·36			42×·38	13×·38			42×·40	13×·40			·30	·32
14000	·40	·42	·44	45	43×·38	13×·38			43×·40	14×·40			43×·42	14×·42			·30	·32
15000	·42	·44	·46	45	44×·38	14×·38			44×·40	15×·40			44×·42	16×·42			·30	·32
16000	·42	·44	·46	45	44×·40	14×·40			45×·42	16×·42			45×·44	18×·44			·30	·32
17000	·44	·46	·48	45	44×·40	19×·40			46×·42	21×·42			47×·44	22×·44			·30	·34
18000	·44	·46	·48	45	44×·42	22×·42	·34		46×·44	23×·44	·36		48×·46	24×·46	·38		·30	·34
19000	·46	·48	·50	46	46×·42	29×·42	·36		48×·44	30×·44	·38		50×·46	31×·46	·40		·30	·34
20000	·46	·48	·50	46	48×·42	34×·42	·36		50×·44	36×·44	·38		52×·46	38×·46	·40		·30	·34
21000	·48	·50	·52	47	50×·44	37×·44	·38		52×·46	39×·46	·40		54×·48	40×·48	·42		·30	·36
22000	·48	·50	·52	48	·40	·32	·38	·32	·42	·32	·40	·32	·44	·32	·42	·32	·32	·36
23000	·50	·52	·54	49	·40	·32	·38	·32	·42	·32	·40	·32	·44	·32	·42	·32	·32	·36
24000	·50	·52	·54	50	·40	·32	·40	·32	·42	·32	·42	·32	·44	·32	·44	·32	·32	·38
25500	·52	·54	·56	51	·42	·32	·40	·32	·44	·32	·42	·32	·46	·32	·44	·32	·32	·38
27000	·52	·54	·56	52	·42	·34	·40	·34	·44	·34	·44	·34	·46	·34	·46	·34	·34	·40
28500	·54	·56	·58	53	·44	·34	·42	·34	·44	·34	·44	·34	·48	·34	·46	·34	·34	·40
30000	·54	·56	·58	54	·44	·34	·42	·34	·46	·36	·46	·34	·48	·36	·48	·34	·34	·40
31500	·56	·58	·60	55	·44	·36	·42	·36	·46	·38	·46	·36	·50	·38	·50	·36	·36	·42
33000	·56	·58	·60	56	·46	·36	·44	·36	·48	·38	·48	·36	·50	·40	·50	·36	·36	·42
34500	·58	·60	·62	57	·48	·36	·46	·36	·50	·40	·48	·38	·52	·42	·52	·38	·36	·42
36000	·58	·60	·62	58	·48	·36	·48	·36	·52	·40	·50	·38	·56	·42	·52	·38	·36	·42
37500	·60	·62	·64	59	·50	·38	·50	·38	·54	·42	·52	·40	·58	·44	·54	·40	·38	·44

* Where a Steel Deck is prescribed to be fitted at the Bridge Deck, the deck below the Bridge Deck is to be a Steel Deck.

PARTIAL SUPERSTRUCTURES.

FULL SCANTLING VESSELS.

TABLE 22

(See Continuation.)

SECOND LONGITUDINAL NUMERAL. L × (B + D)	PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. THICKNESS OF BRIDGE SIDE PLATING.			BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 10										Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES.											
	40	60	80		40				60				80			
					THICKNESS OF "LONG" BRIDGE DECK.											
					When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.			
					Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
39000	·60	·62	·64	60	·50	·42	·50	·40	·54	·46	·52	·40	·58	·48	·54	·40	·38	·44
40500	·62	·64	·66	61	·54	·44	·52	·40	·56	·48	·54	·42	·60	·52	·56	·42	·40	·44
42000	·62	·64	·66	62	·56	·48	·54	·40	·58	·52	·56	·42	·60	·54	·60	·44	·40	·46
43500	·62	·64	·66	63			·54	·42			·56	·44			·60	·46	·42	·46
45000	·64	·66	·68	64			·58	·42			·60	·46			·62	·48	·42	·46
46500	·64	·66	·68	65			·58	·44			·60	·48			·62	·52	·42	·46
48000	·66	·68	·70	66			·60	·46			·62	·50			·64	·54	·42	·48
50000	·66	·68	·70	68			·60	·50			·62	·54			·64	·56	·44	·48
52000	·68	·70	·72	69			·62	·54			·64	·58			·66	·60	·44	·48
54000	·68	·70	·72	70			·62	·58			·66	·62			·68	·64	·44	·48
56000	·68	·72	·74	72			·64	·62			·66	·66			·68	·68	·46	·48
58000	·68	·72	·74	74			·66	·66			·70	·70			·72	·72	·46	·48
60000	·70	·74	·76	76			·70	·70			·72	·72			·74	·74	·46	·48
62000	·70	·74	·76	78			·74	·74			·76	·76			·78	·78	·48	·48
64000	·72	·76	·78	79			·76	·76			·80	·80			·82	·82	·48	·48
66000	·72	·76	·78	80			·80	·80			·84	·84			·86	·86	·48	·48
68000	·74	·78	·80	81			·84	·84			·86	·86			·88	·88	·48	·48
70000	·74	·78	·80	83			·86	·86			·90	·90			·92	·92	·50	·50
72000	·76	·80	·82	85			·90	·90			·92	·92			·94	·94	·50	·50
74000	·76	·80	·84	86			·92	·92			·94	·94			·96	·96	·50	·50
76000	·78	·82	·86	88			·94	·94			·98	·98			1·00	1·00	·50	·50

PARTIAL SUPERSTRUCTURES.

FULL SCANTLING VESSELS.

TABLE 22

(See Continuation.)

PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK.

11

SECOND LONGITUDINAL NUMERAL. L×(B+D)	PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES.			BREADTH OF STRINGER PLATE.	PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. 40 — THICKNESS OF "LONG" BRIDGE DECK.				PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. 60 — THICKNESS OF "LONG" BRIDGE DECK.				PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. 80 — THICKNESS OF "LONG" BRIDGE DECK.				Deck Plating within Line of Deck Openings	Minimum for Unsheathed Deck Plating abreast Deck Openings
	40	60	80		When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.			
	THICKNESS OF BRIDGE SIDE PLATING.				Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	·40	·42	·44	45	42×·38	12×·38			42×·40	12×·40			42×·42	12×·42			·30	·32
13000	·40	·42	·44	45	42×·38	14×·38			42×·40	14×·40			42×·42	14×·42			·30	·32
14000	·40	·42	·44	45	43×·38	16×·38			43×·40	16×·40			43×·42	16×·42			·30	·32
15000	·42	·44	·46	45	44×·40	16×·40			45×·42	17×·42			45×·44	18×·44			·30	·32
16000	·42	·44	·46	45	44×·40	19×·40			46×·42	22×·42			47×·44	24×·44			·30	·32
17000	·44	·46	·48	45	47×·42	22×·42			49×·44	24×·44			51×·46	26×·46			·30	·34
18000	·44	·46	·48	45	50×·42	27×·42	·36		52×·44	29×·44	·36		54×·46	31×·46	·38		·30	·34
19000	·46	·48	·50	46	52×·44	31×·44	·36		52×·46	36×·46	·38		56×·48	35×·48	·40		·30	·34
20000	·46	·48	·50	46	54×·44	38×·44	·36		56×·46	39×·46	·38		58×·48	40×·48	·40		·30	·34
21000	·48	·50	·52	47	·42	·30	·38	·30	·44	·30	·40	·30	·44	·30	·42	·30	·30	·36
22000	·48	·50	·52	48	·42	·32	·38	·32	·44	·32	·40	·32	·44	·32	·42	·32	·32	·36
23000	·50	·52	·54	49	·44	·32	·40	·32	·44	·32	·42	·32	·46	·32	·44	·32	·32	·36
24000	·50	·52	·54	50	·44	·32	·42	·32	·46	·32	·42	·32	·48	·32	·44	·32	·32	·38
25500	·52	·54	·56	51	·46	·34	·42	·34	·48	·34	·44	·34	·50	·34	·46	·34	·32	·38
27000	·52	·54	·56	52	·46	·34	·44	·34	·48	·36	·46	·34	·50	·36	·48	·34	·34	·40
28500	·54	·56	·58	53	·48	·34	·44	·34	·50	·36	·46	·34	·52	·38	·48	·34	·34	·40
30000	·54	·56	·58	54	·48	·36	·44	·36	·50	·38	·48	·36	·52	·42	·50	·36	·34	·40
31500	·56	·58	·60	55	·50	·36	·46	·36	·52	·40	·50	·36	·54	·44	·52	·36	·36	·42
33000	·56	·58	·60	56	·52	·38	·48	·36	·54	·44	·52	·38	·54	·48	·54	·38	·36	·42
34500	·58	·60	·62	57	·54	·42	·48	·38	·56	·46	·52	·38	·56	·50	·56	·40	·36	·42
36000	·58	·60	·62	58	·54	·46	·48	·38	·56	·50	·52	·40	·56	·54	·56	·42	·36	·42
37500	·60	·62	·64	59	·56	·50	·50	·38	·58	·54	·54	·42	·58	·56	·58	·44	·38	·44

* Where a Steel Deck is prescribed to be fitted at the Bridge Deck, the deck below the Bridge Deck is to be a Steel Deck.

PARTIAL SUPERSTRUCTURES.

FULL SCANTLING VESSELS.

TABLE 22 *(Concluded.)*

SECOND LONGITUDINAL NUMERAL. L × (B + D)	PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES. THICKNESS OF BRIDGE SIDE PLATING.			BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 11										Deck Plating within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
					PERCENTAGE OF LENGTH OF VESSEL COVERED BY SUPERSTRUCTURES.											
	40	60	80		40				60				80			
					THICKNESS OF "LONG" BRIDGE DECK.											
					When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.		When Two Steel Decks are Fitted including Bridge Deck.		When Three Steel Decks are Fitted including Bridge Deck.			
					Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
39000	·60	·62	·64	60	·56	·54	·54	·40	·60	·56	·56	·44	·60	·58	·58	·48	·38	·44
40500	·62	·64	·66	61	·58	·56	·56	·44	·60	·60	·58	·48	·62	·62	·60	·50	·40	·44
42000	·62	·64	·66	62	·60	·60	·56	·46	·62	·62	·58	·50	·64	·64	·60	·54	·40	·46
43500	·62	·64	·66	63			·56	·50			·58	·54			·60	·58	·42	·46
45000	·64	·66	·68	64			·58	·52			·60	·58			·62	·62	·42	·46
46500	·64	·66	·68	65			·58	·56			·62	·62			·66	·66	·42	·46
48000	·66	·68	·70	66			·62	·58			·66	·64			·70	·70	·42	·48
50000	·66	·68	·70	68			·64	·64			·70	·70			·74	·74	·44	·48
52000	·68	·70	·72	69			·66	·66			·72	·72			·76	·76	·44	·48
54000	·68	·70	·72	70			·70	·70			·76	·76			·80	·80	·44	·48
56000	·68	·72	·74	72			·74	·74			·78	·78			·82	·82	·46	·48
58000	·68	·72	·74	74			·78	·78			·82	·82			·86	·86	·46	·48
60000	·70	·74	·76	76			·80	·80			·84	·84			·88	·88	·46	·48
62000	·70	·74	·76	78			·84	·84			·88	·88			·92	·92	·48	·48
64000	·72	·76	·78	79			·88	·88			·92	·92			·94	·94	·48	·48
66000	·72	·76	·78	80			·92	·92			·96	·96			·98	·98	·48	·48
68000	·74	·78	·80	81			·94	·94			·98	·98			1·00	1·00	·48	·48
70000	·74	·78	·80	83			·98	·98			1·02	1·02			1·04	1·04	·50	·50
72000	·76	·80	·82	85			1·02	1·02			1·06	1·06			1·08	1·08	·50	·50
74000	·76	·80	·84	86			1·06	1·06			1·10	1·10			1·12	1·12	·50	·50
76000	·78	·82	·86	88			1·08	1·08			1·12	1·12			1·16	1·16	·50	·50

PARTIAL SUPERSTRUCTURES.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 23

(See Continuation.)

SECOND LONGITUDINAL NUMERAL $L \times (B+D)$	THICKNESS OF BRIDGE SIDE PLATING	BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 10 — THICKNESS OF "LONG" BRIDGE DECK.							
			When Two Decks are Fitted Including Bridge Deck.		When Three Steel Decks are Fitted Including Bridge Deck.		When Four Steel Decks are Fitted Including Bridge Deck.		Deck Plating Within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
			Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	·38	45	42×·36	12×·36					·30	·32
13000	·38	45	42×·36	12×·36					·30	·32
14000	·38	45	42×·36	13×·36					·30	·32
15000	·40	45	42×·38	14×·38					·30	·32
16000	·40	45	43×·40	14×·40					·30	·32
17000	·40	45	44×·40	16×·40					·30	·34
18000	·42	45	45×·42	17×·42	·34				·30	·34
19000	·42	46	46×·42	20×·42	·34				·30	·34
20000	·42	46	48×·42	24×·42	·34				·30	·34
21000	·44	47	50×·42	30×·42	·36				·30	·36
22000	·44	48	50×·42	36×·42	·36				·32	·36
23000	·44	49	·36	·32	·36	·32			·32	·36
24000	·46	50	·38	·32	·36	·32			·32	·38
25500	·46	51	·38	·32	·38	·32			·32	·38
27000	·46	52	·38	·34	·38	·34			·34	·40
28500	·48	53	·40	·34	·38	·34			·34	·40
30000	·48	54	·40	·34	·40	·34			·34	·40
31500	·50	55	·40	·36	·40	·36			·36	·42
33000	·50	56	·42	·36	·40	·36			·36	·42
34500	·52	57	·42	·36	·42	·36			·36	·42
36000	·52	58	·44	·36	·42	·36			·36	·42
37500	·52	59	·44	·38	·44	·38			·38	·44
39000	·54	60	·46	·38	·44	·38			·38	·44
40500	·54	61	·46	·40	·46	·40	·46	·40	·40	·44

* Where a Steel Deck is prescribed to be fitted at the Bridge Deck, the deck below the Bridge Deck is to be a Steel Deck.

PARTIAL SUPERSTRUCTURES.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 23

(See Continuation.)

SECOND LONGITUDINAL NUMERAL $L \times (B+D)$	THICKNESS OF BRIDGE SIDE PLATING.	BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 10 — THICKNESS OF "LONG" BRIDGE DECK.							
			When Two Steel Decks are Fitted Including Bridge Deck.		When Three Steel Decks are Fitted Including Bridge Deck.		When Four Steel Decks are Fitted Including Bridge Deck.		Deck Plating Within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
			Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	·56	62	·46	·40	·46	·40	·46	·40	·40	·46
43500	·56	63			·48	·42	·46	·42	·42	·46
45000	·56	64			·48	·42	·48	·42	·42	·46
46500	·58	65			·50	·42	·48	·42	·42	·46
48000	·58	66			·50	·42	·50	·42	·42	·48
50000	·60	68			·52	·44	·50	·44	·44	·48
52000	·60	69			·54	·44	·52	·44	·44	·48
54000	·62	70			·56	·44	·52	·44	·44	·48
56000	·62	72			·56	·48	·54	·46	·46	·48
58000	·64	74			·58	·52	·56	·50	·46	·48
60000	·64	76			·60	·56	·58	·52	·46	·48
62000	·66	77			·62	·58	·60	·54	·48	·48
64000	·66	79			·62	·62	·60	·58	·48	·48
66000	·68	80			·64	·64	·60	·60	·48	·48
68000	·68	81			·68	·68	·64	·64	·48	·48
70000	·70	83			·72	·72	·68	·68	·50	·50
72000	·70	85			·76	·76	·72	·72	·50	·50
74000	·72	86			·80	·80	·76	·76	·50	·50
76000	·72	88			·84	·84	·80	·80	·50	·50
78000	·74	89			·88	·88	·84	·84	·52	·52
80000	·74	90			·92	·92	·88	·88	·52	·52
82000	·76	92			·96	·96	·92	·92	·52	·52
84500	·76	94			1·00	1·00	·96	·96	·54	·54
87000	·76	96			1·04	1·04	1·00	1·00	·54	·54

PARTIAL SUPERSTRUCTURES.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 23

(See Continuation.)

SECOND LONGITUDINAL NUMERAL $L \times (B+D)$	THICKNESS OF BRIDGE SIDE PLATING.	BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 11 — THICKNESS OF "LONG" BRIDGE DECK.							
			When Two Decks are Fitted Including Bridge Deck.		When Three Steel Decks are Fitted Including Bridge Deck.		When Four Steel Decks are Fitted Including Bridge Deck.		Deck Plating Within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
			Stringer Plate.	Tie Plates and Deck Plating.*	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	·38	45	42×·36	12×·36					·30	·32
13000	·38	45	42×·36	13×·36					·30	·32
14000	·38	45	42×·36	14×·36					·30	·32
15000	·40	45	42×·38	15×·38					·30	·32
16000	·40	45	43×·40	17×·40					·30	·32
17000	·40	45	45×·40	20×·40					·30	·34
18000	·42	45	45×·42	24×·42	·34				·30	·34
19000	·42	46	48×·42	28×·42	·34				·30	·34
20000	·42	46	50×·42	32×·42	·34				·30	·34
21000	·44	47	52×·42	36×·42	·36				·30	·36
22000	·44	48	·38	·32	·36	·32			·32	·36
23000	·44	49	·38	·32	·36	·32			·32	·36
24000	·46	50	·40	·32	·36	·32			·32	·38
25500	·46	51	·40	·32	·38	·32			·32	·38
27000	·46	52	·40	·34	·38	·34			·34	·40
28500	·48	53	·42	·34	·40	·34			·34	·40
30000	·48	54	·42	·36	·40	·36			·36	·40
31500	·50	55	·42	·36	·40	·36			·36	·42
33000	·50	56	·44	·36	·42	·36			·36	·42
34500	·52	57	·44	·36	·42	·36			·36	·42
36000	·52	58	·44	·38	·44	·38			·36	·42
37500	·52	59	·46	·38	·44	·38			·38	·44
39000	·54	60	·46	·38	·46	·38			·38	·44
40500	·54	61	·46	·40	·46	·40	·46	·40	·40	·44

* Where a Steel Deck is prescribed to be fitted at the Bridge Deck, the deck below the Bridge Deck is to be a Steel Deck.

PARTIAL SUPERSTRUCTURES.

COMPLETE SUPERSTRUCTURE VESSELS.

TABLE 23 *(Concluded.)*

SECOND LONGITUDINAL NUMERAL $L \times (B+D)$	THICKNESS OF BRIDGE SIDE PLATING.	BREADTH OF STRINGER PLATE.	PROPORTION OF LENGTH OF VESSEL TO DEPTH TO BRIDGE DECK. 11 — THICKNESS OF "LONG" BRIDGE DECK.							
			When Two Steel Decks are Fitted Including Bridge Deck.		When Three Steel Decks are Fitted Including Bridge Deck.		When Four Steel Decks are Fitted Including Bridge Deck.		Deck Plating Within Line of Deck Openings.	Minimum for Unsheathed Deck Plating abreast Deck Openings
			Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.		
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
42000	·56	62	·48	·40	·48	·40	·46	·40	·40	·46
43500	·56	63			·48	·42	·48	·42	·42	·46
45000	·56	64			·48	·42	·48	·42	·42	·46
46500	·58	65			·50	·42	·50	·42	·42	·46
48000	·58	66			·52	·42	·50	·42	·42	·48
50000	·60	68			·54	·44	·52	·44	·44	·48
52000	·60	69			·58	·48	·54	·46	·44	·48
54000	·62	70			·60	·50	·56	·48	·44	·48
56000	·62	72			·60	·54	·56	·52	·46	·48
58000	·64	74			·60	·58	·58	·54	·46	·48
60000	·64	76			·62	·62	·60	·56	·46	·48
62000	·66	77			·64	·64	·60	·60	·48	·48
64000	·66	79			·68	·68	·64	·64	·48	·48
66000	·68	80			·72	·72	·68	·68	·48	·48
68000	·68	81			·76	·76	·72	·72	·48	·48
70000	·70	83			·80	·80	·76	·76	·50	·50
72000	·70	85			·84	·84	·80	·80	·50	·50
74000	·72	86			·88	·88	·84	·84	·50	·50
76000	·72	88			·94	·94	·90	·90	·50	·50
78000	·74	89			1·02	1·02	·98	·98	·52	·52
80000	·74	90			1·08	1·08	1·04	1·04	·52	·52
82000	·76	92					1·12	1·12	·52	·52
84500	·76	94					1·22	1·22	·54	·54
87000	·76	96							·54	·54

TABLE 24

STRINGER ANGLES on UPPER DECKS and LONG BRIDGES.

STRINGER ANGLES.				
THICKNESS OF SHEERSTRAKE OR STRINGER WHICHEVER IS THE GREATER.			DIAMETER OF RIVET AS REQUIRED BY TABLE 38.	SIZES OF FLANGES.*	SPACING OF RIVETS.
Above	Inches and	not exceeding	Inches.	Inches.	Diameters.
—		·36	$\frac{5}{8}$	3 × 3	$4\frac{1}{2}$
·36	„	·50	$\frac{3}{4}$	$3\frac{1}{2}$ × $3\frac{1}{2}$	$4\frac{1}{2}$
·50	„	·56	$\frac{7}{8}$	$3\frac{1}{2}$ × $3\frac{1}{2}$	$4\frac{1}{2}$
·56	„	·72	$\frac{7}{8}$	5 × 5	2 rows, 6 in each row
·72	„	·94	1	6 × 6	2 „ $5\frac{1}{2}$ „
·94	„	1·14	$1\frac{1}{8}$	7 × 7	2 „ $5\frac{1}{2}$ „
1·14	„	1·20	$1\frac{1}{4}$	8 × 8	2 „ 5 „

* The thickness of the Gunwale Angle may be that of the Sheerstrake or Stringer Plate, whichever is the less.

LLOYD'S REGISTER OF SHIPPING, LONDON.—15*th February*, 1945.

"SHORT" SUPERSTRUCTURES. TABLE 25

SECOND LONGITUDINAL NUMERAL. L×(B+D)	"SHORT" SUPERSTRUCTURES.											
	POOPS.				"SHORT" BRIDGES.				FORECASTLES.			
	Thickness of Side Plating.	Stringer Angle.	Thickness.		Thickness of Side Plating.	Stringer Angle.	Thickness.		Thickness of Side Plating.	Stringer Angle.	Thickness.	
			Stringer Plate.	Tie Plates.			Stringer Plate.	Tie Plates and Deck Plating.			Stringer Plate.	Tie Plates and Deck Plating.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1500	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	10×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	14×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	10×·22	5×·22
2000	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	11×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	16×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	11×·22	5×·22
2500	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	11×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	18×·22	5×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	11×·22	5×·22
3000	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	12×·22	6×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	20×·22	6×·22	·22	$2\frac{1}{2}\times2\frac{1}{2}\times$·22	12×·22	6×·22
3700	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	13×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	22×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	13×·24	6×·24
4400	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	13×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	24×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	13×·24	6×·24
5200	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	14×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	26×·24	6×·24	·24	$2\frac{1}{2}\times2\frac{1}{2}\times$·24	14×·24	6×·24
6100	·24	3 ×3 ×·24	15×·24	6×·24	·24	3 ×3 ×·24	28×·24	6×·24	·24	3 ×3 ×·24	15×·24	6×·24
7100	·26	3 ×3 ×·26	16×·26	7×·26	·26	3 ×3 ×·26	30×·26	7×·26	·26	3 ×3 ×·26	16×·26	7×·26
8200	·26	3 ×3 ×·26	17×·26	7×·26	·26	3 ×3 ×·26	31×·26	7×·26	·26	3 ×3 ×·26	17×·26	7×·26
9600	·26	3 ×3 ×·26	18×·26	7×·26	·28	3 ×3 ×·28	32×·28	7×·28	·28	3 ×3 ×·28	18×·28	7×·28
11000	·28	3 ×3 ×·28	20×·28	7×·28	·30	3 ×3 ×·30	33×·30	7×·30	·30	3 ×3 ×·30	20×·30	7×·30
12600	·28	3 ×3 ×·28	22×·28	7×·28	·30	3 ×3 ×·30	33×·30	7×·30	·30	3 ×3 ×·30	22×·30	7×·30
14600	·30	3 ×3 ×·30	24×·30	8×·30	·32	3 ×3 ×·32	34×·32	8×·32	·32	3 ×3 ×·30	24×·30	Dk. Pltg. ·30
17000	·32	3 ×3 ×·30	26×·30	8×·30	·34	3 ×3 ×·34	35×·34	8×·34	·34	3 ×3 ×·32	26×·32	·30
19500	·34	3 ×3 ×·32	28×·32	8×·32	·36	3 ×3 ×·36	36×·36	8×·36	·36	3 ×3 ×·32	28×·32	·30
22200	·34	3 ×3 ×·32	30×·32	8×·32	·38	3 ×3 ×·38	37×·38	9×·38	·38	3 ×3 ×·32	30×·32	·32
25000	·36	3 ×3 ×·32	32×·32	9×·32	·38	3 ×3 ×·38	38×·38	9×·38	·38	3 ×3 ×·32	32×·32	·32
27800	·36	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	33×·34	9×·34	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	38×·40	Dk. Pltg. ·30	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	33×·34	·32
30600	·38	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	34×·34	9×·34	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	39×·40	·30	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	34×·34	·34
33400	·38	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	35×·34	9×·34	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	39×·40	·32	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·34	34×·34	·34
36200	·38	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	36×·36	9×·36	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	40×·42	·32	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	35×·36	·34
39000	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	37×·36	9×·36	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	41×·42	·32	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	35×·36	·34
41800	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	37×·36	10×·36	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	41×·42	·34	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·36	35×·36	·36
44600	·40	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	38×·38	10×·38	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	42×·44	·34	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	36×·38	·36
47400	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	39×·38	10×·38	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	43×·44	·34	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	36×·38	·36
50200	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	39×·38	10×·38	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	43×·44	·36	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·38	36×·38	·36
53000	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	40×·40	10×·40	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·46	44×·46	·36	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	37×·40	·36
55800	·42	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	41×·40	10×·40	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·46	45×·46	·38	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	37×·40	·38
58600	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	41×·40	11×·40	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·46	45×·46	·38	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	37×·40	·38
61400	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	42×·40	11×·40	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·48	46×·48	38	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·40	37×·40	·38
64200	·44	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	43×·42	11×·42	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·48	47×·48	·38	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	38×·42	·38
67000	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	43×·42	11×·42	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·48	47×·48	·38	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	38×·42	·38
69800	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	44×·42	11×·42	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·50	48×·50	·38	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	38×·42	·38
72600	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	44×·42	11×·42	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·50	49×·50	·40	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·42	38×·42	·40
75400	·46	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	45×·44	12×·44	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·50	49×·50	·40	·50	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	39×·44	·40
78200	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	46×·44	12×·44	·52	$3\frac{1}{2}\times3\frac{1}{2}\times$·52	50×·52	·40	·52	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	39×·44	·40
81000	·48	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	46×·44	12×·44	·52	$3\frac{1}{2}\times3\frac{1}{2}\times$·52	51×·52	·40	·52	$3\frac{1}{2}\times3\frac{1}{2}\times$·44	40×·44	·40

LOWER DECKS. TABLE 26

SECOND LONGITUDINAL NUMERAL. $L \times (B+D)$.	ALL LOWER DECKS.	SECOND DECK WHERE A STEEL DECK IS FITTED.			SECOND DECK WHERE STRINGERS AND TIES ARE FITTED		THIRD DECK.		DECKS BELOW THIRD DECK.		ALL LOWER DECKS.			
		HALF LENGTH AMIDSHIPS.									STRINGER ANGLE.			
	Breadth of Stringer Plate for ½-Length Amidships.	Thickness.			Thickness of Stringer Plate.	Tie Plates.	Thickness.		Thickness.		Half Length Amidships.	At Ends.	Stringer Plates at Ends also Thickness of Tie Plates at Ends.	Thickness of Deck Plating at Ends.
		Stringer Plate.	Deck Plating abreast Line of Openings.	Deck Plating Inside Line of Openings.			Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.				
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
9000	41				·34	9×·34					3 ×3 ×·34	·34	24×·34	
10500	41				·34	9×·34					3 ×3 ×·34	·34	25×·34	
12100	42	·34	·30	·30	·36	10×·36					3 ×3 ×·34	·34	26×·34	·30
13800	42	·34	·30	·30	·36	10×·36					3 ×3 ×·34	·34	27×·34	·30
15700	43	·34	·30	·30	·38	11×·38					3 ×3 ×·34	·34	28×·34	·30
17700	43	·34	·30	·30	·40	12×·40					3½×3½×·34	·34	29×·34	·30
19800	44	·34	·30	·30	·42	13×·42	·34	·30			3½×3½×·36	·34	30×·34	·30
22100	44	·34	·30	·30	·42	13×·42	·34	·30			3½×3½×·36	·34	31×·34	·30
24500	45	·36	·32	·30	·44	14×·44	·34	·30			3½×3½×·36	·34	32×·34	·30
27000	45	·36	·32	·32	·44	14×·44	·34	·30			3½×3½×·38	·34	33×·34	·30
29600	46	·38	·34	·32	·46	15×·46	·36	·32			3½×3½×·38	·34	34×·34	·30
32400	47	·38	·34	·32	·46	15×·46	·36	·32			3½×3½×·40	·34	35×·34	·30
35300	47	·40	·36	·34			·36	·32			3½×3½×·40	·34	35×·34	·30
38300	48	·40	·36	·34			·38	·34			3½×3½×·42	·34	36×·34	·30
41400	49	·42	·38	·34			·38	·34			3½×3½×·44	·36	37×·36	·32
44600	50	·44	·40	·34			·38	·34			3½×3½×·44	·36	38×·36	·32
47800	51	·46	·42	·36			·40	·36			3½×3½×·46	·36	39×·36	·32
51000	51	·46	·42	·36			·40	·36			3½×3½×·46	·36	39×·36	·32
54200	52	·48	·44	·36			·40	·36	·38	·34	3½×3½×·48	·36	40×·36	·32
57400	53	·48	·44	·36			·42	·38	·40	·36	3½×3½×·48	·38	41×·38	·34
60600	54	·50	·46	·38			·42	·38	·40	·36	3½×3½×·50	·38	41×·38	·34
63800	54	·50	·46	·38			·44	·40	·40	·36	3½×3½×·50	·38	42×·38	·34
67000	55	·52	·48	·40			·44	·40	·40	·36	3½×3½×·52	·38	43×·38	·34
70400	56	·52	·48	·40			·46	·42	·42	·38	3½×3½×·52	·40	43×·40	·36
74000	57	·54	·50	·40			·46	·42	·42	·38	3½×3½×·54	·40	44×·40	·36
77700	57	·54	·50	·40			·48	·44	·44	·40	4 ×4 ×·54	·40	45×·40	·36
81400	58	·56	·52	·42			·48	·44	·44	·40	4 ×4 ×·56	·40	45×·40	·36
85200	58	·56	·52	·42			·50	·46	·46	·42	4 ×4 ×·56	·42	46×·42	·38
89100	59	·58	·54	·42			·50	·46	·46	·42	4 ×4 ×·58	·42	47×·42	·38
93100	59	·58	·54	·42			·52	·48	·46	·42	4 ×4 ×·58	·42	47×·42	·38
96200	60	·60	·56	·44			·52	·48	·48	·44	4 ×4 ×·60	·42	48×·42	·38

In way of a partial superstructure exceeding 15 per cent. of the vessel's length, the thickness of the second deck may be as required for a third deck, and the thickness of the third deck may be as required for decks below third deck.

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with BRACKET ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 27

(See Continuation.)

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 0	Feet. 2	Feet. 4	Feet. 6	Feet. 8	Feet. 10	Feet. 12
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	ANGLES	4 × 3 × ·30	4½ × 3 × ·30	4½ × 3 × ·34	5 × 3 × ·32	5½ × 3 × ·32	5½ × 3 × ·36	6 × 3 × ·34
9		4½ × 3 × ·32	5 × 3 × ·32	5 × 3 × ·36	5½ × 3 × ·36	6 × 3 × ·36	6 × 3 × ·38	5½ × 3 × ·30
10		5 × 3 × ·34	5½ × 3 × ·34	6 × 3 × ·34	6 × 3 × ·38	5½ × 3 × ·30	6 × 3 × ·32	6 × 3 × ·34
11		5½ × 3 × ·36	6 × 3 × ·36	5½ × 3 × ·30	5½ × 3 × ·36	6 × 3 × ·32	6½ × 3 × ·34	6½ × 3 × ·36
12		6 × 3 × ·38	5½ × 3 × ·32	6 × 3 × ·32	6 × 3 × ·36	6½ × 3 × ·36	7 × 3 × ·36	7 × 3 × ·38
13	BULB ANGLES	5½ × 3 × ·34	6 × 3 × ·34	6½ × 3 × ·34	6½ × 3 × ·38	7 × 3 × ·38	7½ × 3 × ·38	7½ × 3 × ·40
14		6 × 3 × ·34	6½ × 3 × ·34	7 × 3 × ·36	7 × 3 × ·40	7½ × 3 × ·40	8 × 3 × ·40	8 × 3 × ·44
15		6½ × 3 × ·34	7 × 3 × ·36	7½ × 3 × ·38	7½ × 3 × ·42	8 × 3 × ·42	8½ × 3 × ·42	8½ × 3 × ·46
16		7 × 3 × ·36	7½ × 3 × ·38	8 × 3 × ·40	8 × 3 × ·44	8½ × 3 × ·44	9 × 3 × ·44	9 × 3 × ·48
17		7½ × 3 × ·38	8 × 3 × ·40	8½ × 3 × ·42	8½ × 3 × ·46	9 × 3 × ·46	9½ × 3½ × ·46	9½ × 3½ × ·48
18		8 × 3 × ·40	8½ × 3 × ·42	9 × 3 × ·44	9 × 3 × ·48	9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·46
19		8½ × 3 × ·42	9 × 3 × ·44	9 × 3 × ·50	9½ × 3½ × ·48	10 × 3½ × ·48	10½ × 3½ × ·48	11 × 3½ × ·48
20		9 × 3 × ·44	9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·52	11 × 3½ × ·48	11½ × 3½ × ·50
21		9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·46	11 × 3½ × ·48	11 × 3½ × ·50	11½ × 3½ × ·52	12 × 3½ × ·52
22		10 × 3½ × ·46	10½ × 3½ × ·46	11 × 3½ × ·48	11½ × 3½ × ·48	12 × 3½ × ·50	12 × 3½ × ·54	12 × 3½ × 3½ × ·46
23		10½ × 3½ × ·46	11 × 3½ × ·48	11½ × 3½ × ·48	12 × 3½ × ·50	12 × 3½ × ·56	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·56
24		11 × 3½ × ·48 30.0	11½ × 3½ × ·48	12 × 3½ × ·50	12 × 3½ × 3½ × ·46 41.0	12 × 3½ × 3½ × ·50 43.0	12 × 4 × 4 × ·48	12 × 4 × 4 × ·54
25		11½ × 3½ × ·48	12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·50	13 × 4 × 4 × ·48	13 × 4 × 4 × ·52
26		12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·54	13 × 4 × 4 × ·50	13 × 4 × 4 × ·56	
27	CHANNELS	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·50	12 × 4 × 4 × ·50	13 × 4 × 4 × ·54	14 × 4 × 4 × ·50		

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with BRACKET ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 27

(See Continuation.)

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 14	Feet. 16	Feet. 18	Feet. 20	Feet. 22	Feet. 24	Feet. 26
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	ANGLE	6 × 3 × ·36	5½ × 3 × ·30	5½ × 3 × ·30	5½ × 3 × ·34	6 × 3 × ·32	6 × 3 × ·34	6 × 3 × ·38
9	∧	5½ × 3 × ·34	6 × 3 × ·32	6 × 3 × ·34	6½ × 3 × ·34	6½ × 3 × ·38	6½ × 3 × ·40	7 × 3 × ·36
10		6 × 3 × ·36	6½ × 3 × ·34	6½ × 3 × ·38	7 × 3 × ·36	7 × 3 × ·40	7½ × 3 × ·38	7½ × 3 × ·40
11		7 × 3 × ·34	7 × 3 × ·38	7½ × 3 × ·38	7½ × 3 × ·40	8 × 3 × ·40	8 × 3 × ·42	8 × 3 × ·44
12		7½ × 3 × ·38	7½ × 3 × ·40	8 × 3 × ·40	8 × 3 × ·42	8½ × 3 × ·42	8½ × 3 × ·44	9 × 3 × ·44
13		8 × 3 × ·40	8 × 3 × ·44	8½ × 3 × ·48	9 × 3 × ·44	9 × 3 × ·46	9 × 3 × ·48	9½ × 3½ × ·46
14		8½ × 3 × ·42	9 × 3 × ·44	9 × 3 × ·44	9½ × 3½ × ·44	9½ × 3½ × ·46	10 × 3½ × ·46	10 × 3½ × ·48
15	BULB ANGLES	9 × 3 × ·44	9 × 3 × ·50	9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·46	10½ × 3½ × ·48	11 × 3½ × ·48
16		9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·46	10½ × 3½ × ·50	11 × 3½ × ·48	11 × 3½ × ·50	11½ × 3½ × ·50
17		10 × 3½ × ·48	10½ × 3½ × ·48	11 × 3½ × ·48	11½ × 3½ × ·50	11½ × 3½ × ·52	12 × 3½ × ·50	12 × 3½ × ·52
18		11 × 3½ × ·48	11 × 3½ × ·50	11½ × 3½ × ·50	12 × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·50
19		11½ × 3½ × ·50	12 × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·48	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·48
20	∨	12 × 3½ × ·50	12 × 3½ × ·56	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·48	12 × 4 × 4 × ·52	13 × 4 × 4 × ·48
21	∧	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·48	12 × 4 × 4 × ·48	12 × 4 × 4 × ·50	13 × 4 × 4 × ·48	13 × 4 × 4 × ·52	14 × 4 × 4 × ·48
22		12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48	13 × 4 × 4 × ·50	14 × 4 × 4 × ·48	14 × 4 × 4 × ·52	15 × 4 × 4 × ·48
23		12 × 4 × 4 × ·50	13 × 4 × 4 × ·48	14 × 4 × 4 × ·48	14 × 4 × 4 × ·50	15 × 4 × 4 × ·48	15 × 4 × 4 × ·52	
24	CHANNELS	13 × 4 × 4 × ·50	14 × 4 × 4 × ·48	15 × 4 × 4 × ·48	15 × 4 × 4 × ·50			
25								
26								
27	∨							

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with BRACKET ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 27 *(Concluded.)*

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 28	Feet. 30	Feet. 32	Feet. 34	Feet. 36	Feet. 38	Feet. 40
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	BULB ANGLES	$6\frac{1}{2} \times 3 \times \cdot34$	$6\frac{1}{2} \times 3 \times \cdot36$	$6\frac{1}{2} \times 3 \times \cdot38$	$7 \times 3 \times \cdot36$	$7 \times 3 \times \cdot38$	$7 \times 3 \times \cdot40$	$7\frac{1}{2} \times 3 \times \cdot38$
9		$7 \times 3 \times \cdot40$	$7\frac{1}{2} \times 3 \times \cdot36$	$7\frac{1}{2} \times 3 \times \cdot38$	$7\frac{1}{2} \times 3 \times \cdot40$	$8 \times 3 \times \cdot38$	$8 \times 3 \times \cdot40$	$8 \times 3 \times \cdot42$
10		$7\frac{1}{2} \times 3 \times \cdot42$	$8 \times 3 \times \cdot40$	$8 \times 3 \times \cdot42$	$8\frac{1}{2} \times 3 \times \cdot40$	$8\frac{1}{2} \times 3 \times \cdot42$	$8\frac{1}{2} \times 3 \times \cdot46$	$9 \times 3 \times \cdot44$
11		$8\frac{1}{2} \times 3 \times \cdot42$	$8\frac{1}{2} \times 3 \times \cdot44$	$9 \times 3 \times \cdot44$	$9 \times 3 \times \cdot46$	$9 \times 3 \times \cdot48$	$9 \times 3 \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
12		$9 \times 3 \times \cdot44$	$9 \times 3 \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$10 \times 3\frac{1}{2} \times \cdot46$	$10 \times 3\frac{1}{2} \times \cdot50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
13		$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$10 \times 3\frac{1}{2} \times \cdot46$	$10 \times 3\frac{1}{2} \times \cdot48$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$11 \times 3\frac{1}{2} \times \cdot48$	$11 \times 3\frac{1}{2} \times \cdot50$
14		$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$11 \times 3\frac{1}{2} \times \cdot48$	$11 \times 3\frac{1}{2} \times \cdot50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$	$12 \times 3\frac{1}{2} \times \cdot50$
15		$11 \times 3\frac{1}{2} \times \cdot50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$	$12 \times 3\frac{1}{2} \times \cdot50$	$12 \times 3\frac{1}{2} \times \cdot52$	$12 \times 3\frac{1}{2} \times \cdot54$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
16		$12 \times 3\frac{1}{2} \times \cdot50$	$12 \times 3\frac{1}{2} \times \cdot52$	$12 \times 3\frac{1}{2} \times \cdot54$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$12 \times 4 \times 4 \times \cdot48$
17	CHANNELS	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$12 \times 4 \times 4 \times \cdot48$	$12 \times 4 \times 4 \times \cdot50$	$12 \times 4 \times 4 \times \cdot52$	$13 \times 4 \times 4 \times \cdot48$
18		$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot52$	$12 \times 4 \times 4 \times \cdot48$	$12 \times 4 \times 4 \times \cdot50$	$13 \times 4 \times 4 \times \cdot48$	$13 \times 4 \times 4 \times \cdot50$	$13 \times 4 \times 4 \times \cdot52$	$14 \times 4 \times 4 \times \cdot48$
19		$12 \times 4 \times 4 \times \cdot52$	$13 \times 4 \times 4 \times \cdot48$	$13 \times 4 \times 4 \times \cdot50$	$14 \times 4 \times 4 \times \cdot48$	$14 \times 4 \times 4 \times \cdot50$	$15 \times 4 \times 4 \times \cdot48$	$15 \times 4 \times 4 \times \cdot50$
20		$13 \times 4 \times 4 \times \cdot52$	$14 \times 4 \times 4 \times \cdot48$	$14 \times 4 \times 4 \times \cdot50$	$15 \times 4 \times 4 \times \cdot48$	$15 \times 4 \times 4 \times \cdot50$		
21		$14 \times 4 \times 4 \times \cdot52$	$15 \times 4 \times 4 \times \cdot48$	$15 \times 4 \times 4 \times \cdot52$				
22		$15 \times 4 \times 4 \times \cdot52$						
23								
24								
25								
26								
27								

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with LUG ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 28

(See Continuation.)

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 0	Feet. 2	Feet. 4	Feet. 6	Feet. 8	Feet. 10	Feet. 12
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	ANGLES	*4½ × 3 × ·34	5 × 3 × ·36	5½ × 3 × ·38	6 × 3 × ·38	5½ × 3 × ·32	5½ × 3 × ·36	6 × 3 × ·32
9	ANGLES	*5½ × 3 × ·34	6 × 3 × ·32	5½ × 3 × ·32	5½ × 3 × ·36	6 × 3 × ·32	6 × 3 × ·38	6½ × 3 × ·36
10	ANGLES	*6 × 3 × ·38	5½ × 3 × ·34	6 × 3 × ·32	6½ × 3 × ·34	6½ × 3 × ·38	7 × 3 × ·36	7 × 3 × ·40
11	BULB ANGLES	5½ × 3 × ·36	6 × 3 × ·36	6½ × 3 × ·36	7 × 3 × ·36	7 × 3 × ·40	7½ × 3 × ·40	8 × 3 × ·40
12	BULB ANGLES	6 × 3 × ·38	6½ × 3 × ·40	7 × 3 × ·38	7½ × 3 × ·38	7½ × 3 × ·46	8 × 3 × ·44	8½ × 3 × ·44
13	BULB ANGLES	6½ × 3 × ·34	7 × 3 × ·40	7½ × 3 × ·42	8 × 3 × ·42	8½ × 3 × ·42	9 × 3 × ·44	9 × 3 × ·48
14	BULB ANGLES	7 × 3 × ·42	7½ × 3 × ·44	8½ × 3 × ·42	8½ × 3 × ·48	9 × 3 × ·46	9½ × 3½ × ·46	9½ × 3½ × ·50
15	BULB ANGLES	7½ × 3 × ·44	8 × 3 × ·50	9 × 3 × ·44	9 × 3 × ·50	9½ × 3½ × ·48	10 × 3½ × ·48	10½ × 3½ × ·46
16	BULB ANGLES	8½ × 3 × ·42	9 × 3 × ·44	9½ × 3½ × ·46	10 × 3½ × ·46	10 × 3½ × ·52	10½ × 3½ × ·52	11 × 3½ × ·50
17	BULB ANGLES	9 × 3 × ·46	9½ × 3½ × ·46	10 × 3½ × ·48	10½ × 3½ × ·48	11 × 3½ × ·48	11 × 3½ × ·54	11½ × 3½ × ·56
18	BULB ANGLES	9½ × 3½ × ·46	10 × 3½ × ·50	10½ × 3½ × ·52	11 × 3½ × ·50	11½ × 3½ × ·54	12 × 3½ × ·52	12 × 3½ × 3½ × ·46
19	BULB ANGLES	10 × 3½ × ·48	10½ × 3½ × ·50	11 × 3½ × ·52	11½ × 3½ × ·58	12 × 3½ × ·54	12 × 3½ × 3½ × ·46	12 × 4 × 4 × ·48
20	BULB ANGLES	11 × 3½ × ·48	11 × 3½ × ·54	12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·48	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48
21	BULB ANGLES	11 × 3½ × ·54	12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48	14 × 4 × 4 × ·48
22	BULB ANGLES	12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·52	12 × 4 × 4 × ·52	13 × 4 × 4 × ·48	14 × 4 × 4 × ·48	15 × 4 × 4 × ·48
23	CHANNELS	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·54	13 × 4 × 4 × ·52	14 × 4 × 4 × ·48	15 × 4 × 4 × ·48	
24	CHANNELS	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·56	13 × 4 × 4 × ·54	14 × 4 × 4 × ·52	15 × 4 × 4 × ·50		
25	CHANNELS	12 × 4 × 4 × ·54	13 × 4 × 4 × ·56	14 × 4 × 4 × ·54	15 × 4 × 4 × ·52			
26	CHANNELS	13 × 4 × 4 × ·54	14 × 4 × 4 × ·56	15 × 4 × 4 × ·54				
27	CHANNELS	14 × 4 × 4 × ·54	15 × 4 × 4 × ·56					

The ends of upper 'tween deck stiffeners marked * may be riveted to boundary bars only. (No lug attachments.)

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with LUG ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 28

(See Continuation.)

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 14	Feet. 16	Feet. 18	Feet. 20	Feet. 22	Feet. 24	Feet. 26
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	BULB ANGLES	6 × 3 × ·40	6½ × 3 × ·34	6½ × 3 × ·38	7 × 3 × ·36	7 × 3 × ·38	7 × 3 × ·42	7½ × 3 × ·38
9		7 × 3 × ·36	7 × 3 × ·40	7 × 3 × ·46	7½ × 3 × ·40	8 × 3 × ·40	8 × 3 × ·42	8½ × 3 × ·42
10		7½ × 3 × ·38	7½ × 3 × ·44	8 × 3 × ·42	8½ × 3 × ·42	8½ × 3 × ·46	9 × 3 × ·44	9 × 3 × ·46
11		8 × 3 × ·44	8½ × 3 × ·42	8½ × 3 × ·48	9 × 3 × ·46	9 × 3 × ·50	9½ × 3½ × ·46	10 × 3½ × ·46
12		9 × 3 × ·44	9 × 3 × ·46	9½ × 3½ × ·46	9½ × 3½ × ·50	10 × 3½ × ·48	10½ × 3½ × ·40	10½ × 3½ × ·46
13		9½ × 3½ × ·46	9½ × 3½ × ·50	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·48	11 × 3½ × ·50	11½ × 3½ × ·50
14		10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·48	11 × 3½ × ·52	11½ × 3½ × ·54	12 × 3½ × ·50	12 × 3½ × ·56
15		11 × 3½ × ·48	11 × 3½ × ·52	11½ × 3½ × ·54	12 × 3½ × ·50	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·48	12 × 3½ × 3½ × ·52
16		11 × 3½ × ·52	12 × 3½ × ·50	12 × 3½ × ·56	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48
17		12 × 3½ × ·54	12 × 3½ × 3½ × ·46	12 × 3½ × 3½ × ·54	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48	13 × 4 × 4 × ·50	14 × 4 × 4 × ·48
18	CHANNELS	12 × 3½ × 3½ × ·50	12 × 4 × 4 × ·48	13 × 4 × 4 × ·48	13 × 4 × 4 × ·50	14 × 4 × 4 × ·48	14 × 4 × 4 × ·52	15 × 4 × 4 × ·48
19		12 × 4 × 4 × ·52	13 × 4 × 4 × ·48	14 × 4 × 4 × ·48	14 × 4 × 4 × ·52	15 × 4 × 4 × ·48		
20		13 × 4 × 4 × ·52	14 × 4 × 4 × ·48	15 × 4 × 4 × ·48	15 × 4 × 4 × ·54			
21		14 × 4 × 4 × ·52	15 × 4 × 4 × ·52					
22								
23								
24								
25								
26								
27								

BULKHEAD STIFFENERS spaced 30 INCHES apart and fitted with LUG ATTACHMENTS at top and bottom in accordance with Table 30.

TABLE 28 *(Concluded.)*

Overall Length of Stiffener, including End Attachments.		HEIGHT OF TOP OF BULKHEAD AT MIDDLE LINE ABOVE TOP OF STIFFENER.						
		Feet. 28	Feet. 30	Feet. 32	Feet. 34	Feet. 36	Feet. 38	Feet. 40
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	BULB ANGLES ^	$7\frac{1}{2} \times 3 \times \cdot44$	$8 \times 3 \times \cdot40$	$8 \times 3 \times \cdot42$	$8 \times 3 \times \cdot46$	$8\frac{1}{2} \times 3 \times \cdot44$	$8\frac{1}{2} \times 3 \times \cdot46$	$8\frac{1}{2} \times 3 \times \cdot48$
9		$8\frac{1}{2} \times 3 \times \cdot46$	$8\frac{1}{2} \times 3 \times \cdot48$	$9 \times 3 \times \cdot44$	$9 \times 3 \times \cdot46$	$9 \times 3 \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$
10		$9 \times 3 \times \cdot50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$10 \times 3\frac{1}{2} \times \cdot46$	$10 \times 3\frac{1}{2} \times \cdot48$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$
11		$10 \times 3\frac{1}{2} \times \cdot48$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$11 \times 3\frac{1}{2} \times \cdot48$	$11 \times 3\frac{1}{2} \times \cdot50$	$11 \times 3\frac{1}{2} \times \cdot52$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$
12		$11 \times 3\frac{1}{2} \times \cdot48$	$11 \times 3\frac{1}{2} \times \cdot52$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot54$	$12 \times 3\frac{1}{2} \times \cdot50$	$12 \times 3\frac{1}{2} \times \cdot54$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$
13	v	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot54$	$12 \times 3\frac{1}{2} \times \cdot50$	$12 \times 3\frac{1}{2} \times \cdot56$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot50$	$12 \times 4 \times 4 \times \cdot48$
14	CHANNELS ^	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot46$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot48$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \cdot54$	$12 \times 4 \times 4 \times \cdot48$	$12 \times 4 \times 4 \times \cdot50$	$13 \times 4 \times 4 \times \cdot48$	$14 \times 4 \times 4 \times \cdot48$
15		$12 \times 4 \times 4 \times \cdot48$	$12 \times 4 \times 4 \times \cdot52$	$13 \times 4 \times 4 \times \cdot48$	$13 \times 4 \times 4 \times \cdot50$	$14 \times 4 \times 4 \times \cdot48$	$14 \times 4 \times 4 \times \cdot50$	$15 \times 4 \times 4 \times \cdot48$
16		$13 \times 4 \times 4 \times \cdot50$	$14 \times 4 \times 4 \times \cdot48$	$14 \times 4 \times 4 \times \cdot50$	$15 \times 4 \times 4 \times \cdot48$	$15 \times 4 \times 4 \times \cdot50$	$15 \times 4 \times 4 \times \cdot52$	
17		$14 \times 4 \times 4 \times \cdot52$	$15 \times 4 \times 4 \times \cdot48$	$15 \times 4 \times 4 \times \cdot52$				
18		$15 \times 4 \times 4 \times \cdot54$						
19								
20								
21								
22								
23								
24								
25								
26								
27	v							

TABLE 29

BULKHEAD STIFFENERS in TUGS.

OVERALL LENGTH OF STIFFENERS INCLUDING END ATTACHMENTS.		STIFFENERS BRACKETED AT ENDS.	STIFFENERS WITHOUT BRACKETS OR LUGS AT ENDS.
Feet.		Inches.	Inches.
7	ANGLES	—	$3\frac{1}{2} \times 3 \times \cdot 30$
8		$3 \times 3 \times \cdot 28$	$4 \times 3 \times \cdot 30$
9		$3 \times 3 \times \cdot 30$	$4 \times 3 \times \cdot 32$
10		$3\frac{1}{2} \times 3 \times \cdot 32$	$4\frac{1}{2} \times 3 \times \cdot 34$
11		$4 \times 3 \times \cdot 32$	$5 \times 3 \times \cdot 34$
12		$4\frac{1}{2} \times 3 \times \cdot 32$	$5\frac{1}{2} \times 3 \times \cdot 34$
13		$5 \times 3 \times \cdot 32$	$6 \times 3 \times \cdot 36$
14		$5\frac{1}{2} \times 3 \times \cdot 34$	$6\frac{1}{2} \times 3 \times \cdot 36$
15		$6 \times 3 \times \cdot 36$	$6\frac{1}{2} \times 3 \times \cdot 38$
16		$6\frac{1}{2} \times 3 \times \cdot 36$	—

Stiffeners spaced 24 inches apart on collision bulkhead and 30 inches apart on other bulkheads.

ATTACHMENT for STIFFENERS. TABLE 30

TYPE AND DEPTH OF STIFFENER.		BRACKET ATTACHMENTS.			LUG ATTACHMENTS.
		Thickness of Bracket.	Width of Flange.	Number and Size of Rivets in each Arm of Bracket.	Number and Size of Rivets in Lugs.
		Inches.	Inches.		
Angles		·34	—	3 of $\frac{3}{4}$ Ins. Dia.	2 of $\frac{3}{4}$ Ins. Dia.
Bulb Angles under $6\frac{1}{2}$ inches		·36	—	3 „ $\frac{3}{4}$ „ „	2 „ $\frac{3}{4}$ „ „
Bulb Angles $6\frac{1}{2}$ „		·38	—	3 „ $\frac{3}{4}$ „ „	2 „ $\frac{3}{4}$ „ „
„ „ 7 and $7\frac{1}{2}$ „		·40	—	4 „ $\frac{3}{4}$ „ „	3 „ $\frac{3}{4}$ „ „
„ „ 8 „ $8\frac{1}{2}$ „		·42	—	5 „ $\frac{3}{4}$ „ „	3 „ $\frac{3}{4}$ „ „
„ „ 9 „ $9\frac{1}{2}$ „	FLANGED	·34	$2\frac{1}{4}$	6 „ $\frac{3}{4}$ „ „	4 „ $\frac{3}{4}$ „ „
„ „ 10 „ $10\frac{1}{2}$ „		·36	$2\frac{1}{2}$	7 „ $\frac{3}{4}$ „ „	4 „ $\frac{3}{4}$ „ „
„ „ 11 „ $11\frac{1}{2}$ „		·38	$2\frac{3}{4}$	7 „ $\frac{7}{8}$ „ „	4 „ $\frac{7}{8}$ „ „
„ „ 12 „		·40	3	8 „ $\frac{7}{8}$ „ „	5 „ $\frac{7}{8}$ „ „
Channels $12 \times 3\frac{1}{2} \times 3\frac{1}{2}$ „		·40	3	9 „ $\frac{7}{8}$ „ „	6 „ $\frac{7}{8}$ „ „
„ $12 \times 4 \times 4$ „		·40	3	10 „ $\frac{7}{8}$ „ „	7 „ $\frac{7}{8}$ „ „
„ $13 \times 4 \times 4$ „		·42	$3\frac{1}{2}$	11 „ $\frac{7}{8}$ „ „	7 „ $\frac{7}{8}$ „ „
„ $14 \times 4 \times 4$ „		·42	$3\frac{1}{2}$	12 „ $\frac{7}{8}$ „ „	8 „ $\frac{7}{8}$ „ „
„ $15 \times 4 \times 4$ „		·44	$3\frac{1}{2}$	13 „ $\frac{7}{8}$ „ „	8 „ $\frac{7}{8}$ „ „

BULKHEAD PLATING. TABLE 31

STIFFENERS SPACED 30 INCHES APART.				STIFFENERS SPACED 36 INCHES APART.			
Depth at Middle Line from top of Bulkhead to Lower Edge of Plate.	Thickness.	Depth at Middle Line from top of Bulkhead to Lower Edge of Plate.	Thickness.	Depth at Middle Line from top of Bulkhead to Lower Edge of Plate.	Thickness.	Depth at Middle Line from top of Bulkhead to Lower Edge of Plate.	Thickness.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
8	·26	36	·40	7	·28	35	·44
12	·28	40	·42	10·5	·30	38·5	·46
16	·30	44	·44	14	·32	42	·48
20	·32	48	·46	17·5	·34	45·5	·50
24	·34	52	·48	21	·36	49	·52
28	·36	56	·50	24·5	·38	52·5	·54
32	·38	60	·52	28	·40	56	·56
				31·5	·42	59·5	·58

TUNNEL STIFFENERS SPACED 36 ins. APART. TABLE 32

Mean Height from Base of Tunnel to Bulkhead Deck.		HEIGHT FROM BASE OF TUNNEL TO TOP OF FLAT SIDE.						
		Feet. 3	Feet. 4	Feet. 5	Feet. 6	Feet. 7	Feet. 8	
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	
12	ANGLES	3 ×2½×·24	4 ×3 ×·26	4½×3 ×·30	5 ×3 ×·34	5½×3 ×·36	5½×3 ×·30	BULB ANGLES
16		3½×2½×·22	4 ×3 ×·30	5 ×3 ×·32	5½×3 ×·36	5½×3 ×·30	6 ×3 ×·32	
20		3½×2½×·26	4½×3 ×·30	5½×3 ×·34	6 ×3 ×·38	6 ×3 ×·32	6½×3 ×·34	
24		4 ×3 ×·28	5 ×3 ×·32	6 ×3 ×·32	5½×3 ×·34	6 ×3 ×·36	7 ×3 ×·36	
28		4 ×3 ×·30	5 ×3 ×·36	6 ×3 ×·40	6 ×3 ×·32	6½×3 ×·38	7½×3 ×·38	
32		4½×3 ×·30	5½×3 ×·34	5½×3 ×·34	6½×3 ×·34	7 ×3 ×·38	8 ×3 ×·40	
36		4½×3 ×·32	6 ×3 ×·32	6 ×3 ×·32	6½×3 ×·38	7½×3 ×·36	8 ×3 ×·44	
40		4½×3 ×·34	6 ×3 ×·38	6 ×3 ×·34	7 ×3 ×·36	8 ×3 ×·40	8½×3 ×·46	
44		5 ×3 ×·32	6 ×3 ×·40	6½×3 ×·34	7½×3 ×·38	8 ×3 ×·44	9 ×3 ×·44	
48		5 ×3 ×·36	5½×3 ×·30	6½×3 ×·36	7½×3 ×·40	8½×3 ×·42	9 ×3 ×·50	
52		5½×3 ×·34	5½×3 ×·34	7 ×3 ×·36	8 ×3 ×·40	9 ×3 ×·44	9½×3½×·48	
56		5½×3 ×·36	6 ×3 ×·32	7 ×3 ×·38	8 ×3 ×·44	9 ×3 ×·50	10 ×3½×·46	
60		6 ×3 ×·32	6 ×3 ×·34	7½×3 ×·38	8½×3 ×·42	9½×3½×·46	10½×3½×·46	

Angle stiffeners of 6 inches in depth and all bulb angle stiffeners are to be connected to the inner bottom plating by a lug.

HORIZONTAL GIRDERS in OIL FUEL TANKS. TABLE 33

VALUES OF $\frac{S^2 \times D \times H}{100}$		GIRDER.		VALUES OF $\frac{S^2 \times D \times H}{100}$		GIRDER.	
		Intercostal.	Face Bars.			Intercostal.	Face Bars.
		Inches.	Inches.			Inches.	Inches.
140	<-ANGLES->	12 × ·38	5 × 3 × ·34	1030	^	33 × ·40	8 × 3 × ·46
180	<-ANGLES->	15 × ·38	4½ × 3 × ·30	1100	BULB ANGLES	33 × ·40	9 × 3 × ·50
220	^	15 × ·38	6 × 3 × ·30	1190	BULB ANGLES	33 × ·40	10 × 3½ × ·48
260	BULB ANGLES	15 × ·38	6 × 3 × ·42	1260	BULB ANGLES	36 × ·42	8½ × 3 × ·50
300	BULB ANGLES	18 × ·38	6 × 3 × ·34	1340	BULB ANGLES	36 × ·42	9½ × 3½ × ·48
340	BULB ANGLES	18 × ·38	6½ × 3 × ·42	1420	BULB ANGLES	36 × ·42	10 × 3½ × ·52
380	BULB ANGLES	21 × ·40	6 × 3 × ·34	1500	BULB ANGLES	39 × ·44	9 × 3 × ·50
420	BULB ANGLES	21 × ·40	7 × 3 × ·36	1580	BULB ANGLES	39 × ·44	10 × 3½ × ·48
460	BULB ANGLES	21 × ·40	7½ × 3 × ·40	1685	BULB ANGLES	39 × ·44	10 × 3½ × ·56
500	BULB ANGLES	21 × ·40	7½ × 3 × ·46	1795	BULB ANGLES	42 × ·46	9 × 3½ × ·54
550	BULB ANGLES	24 × ·40	7 × 3 × ·44	1905	BULB ANGLES	42 × ·46	10 × 3½ × ·56
600	BULB ANGLES	24 × ·40	7½ × 3 × ·48	2070	BULB ANGLES	42 × ·46	11 × 3½ × ·60
650	BULB ANGLES	27 × ·40	7 × 3 × ·40	2190	BULB ANGLES	45 × ·48	10 × 3½ × ·58
700	BULB ANGLES	27 × ·40	7½ × 3 × ·44	2330	BULB ANGLES	45 × ·48	11 × 3½ × ·60
750	BULB ANGLES	27 × ·40	8 × 3 × ·48	2470	BULB ANGLES	45 × ·48	12 × 3½ × ·60
800	BULB ANGLES	27 × ·40	8½ × 3 × ·50	2610	BULB ANGLES	48 × ·50	11½ × 3½ × ·56
850	BULB ANGLES	30 × ·40	8 × 3 × ·42	2750	BULB ANGLES	48 × ·50	12 × 3½ × ·60
910	BULB ANGLES	30 × ·40	8 × 3 × ·50	2890	BULB ANGLES	48 × ·50	12 × 3½ × ·68
970	v	30 × ·40	9 × 3 × ·50		v		

VERTICAL STIFFENERS on BOUNDARY BULKHEADS of OIL FUEL BUNKERS and DEEP WATER BALLAST TANKS.

TABLE 34

Overall Length of Stiffener including End Attachments.		HEAD H							
		Feet. 0	Feet. 4	Feet. 8	Feet. 12	Feet. 16	Feet. 20	Feet. 24	Feet. 28
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
5	ANGLES ^	3 ×3 ×·24	4 ×3 ×·26	5 ×3 ×·36	6 ×3 ×·38	6½×3 ×·42	6 ×3 ×·36	6 ×3 ×·40	6½×3 ×·38
6		3½×3 ×·28	5 ×3 ×·34	6 ×3 ×·38	6½×3 ×·44	6 ×3 ×·36	6½×3 ×·40	7 ×3 ×·42	7½×3 ×·40
7		4 ×3 ×·36	5½×3 ×·42	6½×3 ×·46	6 ×3 ×·36	6½×3 ×·40	7 ×3 ×·42	8 ×3 ×·44	8½×3 ×·42
8		5 ×3 ×·36	6 ×3 ×·36	6 ×3 ×·36	6½×3 ×·44	7½×3 ×·44	8 ×3 ×·44	8½×3 ×·46	9 ×3 ×·50
9		5½×3 ×·42	6 ×3 ×·42	6½×3 ×·44	7 ×3 ×·50	8½×3 ×·44	9 ×3 ×·46	9½×3½×·46	10 ×3½×·50
10	v	6 ×3 ×·48	6½×3 ×·36	7½×3 ×·40	8 ×3 ×·50	9 ×3 ×·50	10 ×3½×·50	10½×3½×·50	11 ×3½×·50
11	^	6 ×3 ×·40	7 ×3 ×·44	8 ×3 ×·50	9 ×3 ×·50	10 ×3½×·50	10½×3½×·60	11 ×3½×·60	12 ×3½×·54
12		7 ×3 ×·34	8 ×3 ×·38	9 ×3 ×·44	10 ×3½×·50	10½×3½×·60	11 ×3½×·68	12 ×3½×·60	12×3½×3½×·60
13		7½×3 ×·40	8½×3 ×·44	9½×3 ×·50	10½×3½×·60	11 ×3½×·66	12 ×3½×·68	12×3½×3½×·60	13×4 ×4 ×·60
14		8 ×3 ×·50	9 ×3 ×·54	10 ×3½×·60	11 ×3½×·68	12 ×3½×·66	12×3½×3½×·62	13×4 ×4 ×·60	14×4 ×4 ×·62
15	BULB ANGLES	8½×3 ×·58	10 ×3½×·54	11 ×3½×·58	12 ×3½×·68	12×3½×3½×·60	13×4 ×4 ×·62	14×4 ×4 ×·62	15×4 ×4 ×·66
16		9½×3½×·52	10½×3½×·60	12 ×3½×·56	12×3½×3½×·60	13×4 ×4 ×·60	14×4 ×4 ×·64	15×4 ×4 ×·66	
17		10 ×3½×·60	11 ×3½×·66	12×3½×3½×·58	12×4 ×4 ×·70	14×4 ×4 ×·64	15×4 ×4 ×·66		
18		11 ×3½×·56	12 ×3½×·66	12×4 ×4 ×·68	14×4 ×4 ×·66	15×4 ×4 ×·66			
19	v	11 ×3½×·66	12×3½×3½×·66	13×4 ×4 ×·68	15×4 ×4 ×·68				
20	^	12×3½×3½×·60	13×4 ×4 ×·66						
21		12×4 ×4 ×·64	14×4 ×4 ×·66						
22		13×4 ×4 ×·66							
23		14×4 ×4 ×·68							
24	CHANNELS v	15×4 ×4 ×·70							

NON-WATERTIGHT BULKHEADS. TABLE 35

OVERALL LENGTH OF STIFFENER.		* STIFFENERS TWO FRAME SPACES APART FITTED TO NON-WATERTIGHT MIDDLE LINE BULKHEADS ACTING IN LIEU OF A ROW OF PILLARS.			* STIFFENERS TWO FRAME SPACES APART FITTED TO LONGITUDINAL BUNKER BULKHEADS ACTING IN LIEU OF A ROW OF PILLARS.			* STIFFENERS TWO FRAME SPACES APART FITTED TO LONGITUDINAL BUNKER BULKHEADS NOT ACTING IN LIEU OF A ROW OF PILLARS.	STIFFENERS TO TRANSVERSE BUNKER BULKHEADS SPACED 36 INCHES APART.
		Under Upper Deck.	Under Second Deck.	Under Third Deck.	Under Upper Deck.	Under Second Deck.	Under Third Deck.		
Feet.		Inches.	Inches.	Inches.	Inches.	Inches	Inches.	Inches.	Inches.
8	ANGLES	5 ×3 ×·30	5½×3 ×·36	5½×3 ×·36	4½×3 ×·32	5½×3 ×·32	5 ×3 ×·40	4 ×3 ×·30	4 ×3×·30
10	ANGLES	5 ×3 ×·32	6 ×3 ×·40	6 ×3 ×·36	4½×3 ×·34	6 ×3 ×·36	5½×3 ×·40	4½×3 ×·30	4½×3×·30
12	ANGLES	5 ×3 ×·36	5½×3 ×·40	6½×3 ×·38	4½×3 ×·38	6½×3 ×·40	6 ×3 ×·40	4½×3 ×·34	4½×3×·34
14	ANGLES	5½×3 ×·36	6½×3 ×·40	7 ×3 ×·42	5 ×3 ×·38	6 ×3 ×·40	6½×3 ×·42	5 ×3 ×·34	5 ×3×·34
16	BULB ANGLES	5½×3 ×·38	7½×3 ×·40	8 ×3 ×·46	6 ×3 ×·38	7 ×3 ×·40	7½×3 ×·44	6 ×3 ×·34	6 ×3×·34
18	BULB ANGLES	6½×3 ×·40	8 ×3 ×·46	9 ×3 ×·50	6 ×3 ×·40	7½×3 ×·46	8½×3 ×·46	6 ×3 ×·34	5½×3×·36
20	BULB ANGLES	7 ×3 ×·44	9 ×3 ×·48	10 ×3½×·52	6½×3 ×·42	8½×3 ×·46	9½×3½×·48	6½×3 ×·38	6 ×3×·36
22	BULB ANGLES	8 ×3 ×·44	10 ×3½×·48	11 ×3½×·54	7½×3 ×·42	9½ ×3½×·46	10½×3½×·48	7½×3 ×·38	6½×3×·38
24	BULB ANGLES	9 ×3 ×·44	10½×3½×·50	12 ×3½×·54	8½×3 ×·42	10 ×3½×·46	11 ×3½×·56	8 ×3 ×·40	7 ×3×·40
26	BULB ANGLES	9½×3½×·46	11½×3½×·50		9 ×3 ×·42	10½×3½×·54	12 ×3½×·52	8½×3 ×·44	7½×3×·42
28	BULB ANGLES	10 ×3½×·48	12 ×3½×·54		9½×3½×·44	11 ×3½×·56		9 ×3 ×·44	8 ×3×·42
30	BULB ANGLES	10½×3½×·50			10 ×3½×·44	12 ×3½×·56		9½×3½×·46	8 ×3×·46

* Where frames are spaced not more than 30 inches apart.

LLOYD'S REGISTER OF SHIPPING, LONDON.—12*th April*, 1923.

HATCH WEBS.

TABLE A.

TABLE 36

(See Continuation.)

HATCHWAY BEAMS.

BREADTH OF HATCHWAY.	WITHOUT FORE AND AFTERS. Spacing Centre to Centre.		WITH FORE AND AFTERS. Spacing Centre to Centre.			ANGLES ON EDGES OF WEBS.
	Feet. 4	Feet. 5	Feet. 6	Feet. 8	Feet. 10	
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	9 ×·46 B.P.	10 ×·50 B.P.	11 ×·30	12 ×·32	14 ×·34	3 × 3 ×·40
12	11 ×·50 B.P.	12 ×·50 B.P.	12 ×·32	14 ×·34	17 ×·36	3 × 3 ×·40
14	12 ×·50 B.P.	12 ×·32	14 ×·34	17 ×·36	20 ×·38	3 × 3 ×·42
16	12 ×·32	14 ×·34	16 ×·36	19 ×·38	22 ×·38	3½ × 3 ×·42
18	14 ×·34	16 ×·36	18 ×·36	21 ×·38	25 ×·40	4 × 3 ×·44
20	15 ×·34	18 ×·36	20 ×·38	24 ×·40	28 ×·42	4 × 3 ×·44
22	16 ×·36	19 ×·36	22 ×·38	26 ×·42	30 ×·44	4½ × 3 ×·46
24	17 ×·36	20 ×·38	23 ×·40	28 ×·42	32 ×·44	5 × 3½ ×·46
26	18 ×·36	21 ×·38	24 ×·40	29 ×·42	34 ×·46	5½ × 3½ ×·48
28	19 ×·38	22 ×·38	25 ×·40	31 ×·44	36 ×·48	6 × 3½ ×·50
30	20 ×·38	23 ×·40	26 ×·42	32 ×·44	38 ×·48	6 × 3½ ×·52

The depths are measured from the top edge of uppermost mounting to lower edge of lower mounting at the middle of the beam.
The depth at the ends is to be one half of the depth at the middle, but in no case less than 6 inches.
The larger flanges of the mounting angles are to be fitted horizontally.

CENTRE FORE AND AFTERS.†

LENGTH OF FORE AND AFTER.	STEEL BULB PLATE. Spacing of Fore and Afters.			DOUBLE ANGLES ON UPPER EDGE.	WOOD. Spacing of Fore and Afters.					
	Feet. 3	Feet. 4	Feet. 5		Feet. 3		Feet. 4		Feet. 5	
Feet.	Inches.	Inches.	Inches.	Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.
6	6 ×·36	6½ ×·38	7 ×·38	2½ × 2½ ×·36	5½	7	6	7	6½	7
8	7 ×·42	8 ×·44	9 ×·44	2½ × 2½ ×·38	6½	7	7½	7	8	7
10	8 ×·50	9½ ×·50	11 ×·50	2½ × 2½ ×·40	8	7	8½	8	9	9

SIDE FORE AND AFTERS.†

LENGTH OF FORE AND AFTER.	STEEL BULB ANGLE. Spacing of Fore and Afters.			ANGLE ON UPPER EDGE OF BULB ANGLE.	WOOD. Spacing of Fore and Afters.					
	Feet. 3	Feet. 4	Feet. 5		Feet. 3		Feet. 4		Feet. 5	
Feet.	Inches.	Inches.	Inches.	Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches	Breadth. Inches.
6	6 × 3 ×·36	6½ × 3½ ×·38	7 × 3½ ×·38	2½ × 2½ ×·36	5½	5½	6	6	6½	6
8	7 × 3½ ×·42	8 × 3½ ×·44	9 × 3½ ×·44	2½ × 2½ ×·38	6½	6½	7½	7	8	7
10	8 × 3½ ×·50	9½ × 3½ ×·50	11 × 3½ ×·50	2½ × 2½ ×·40	8	7	8½	8	9	9

† Depths of fore and afters are measured to under side of covers, and the bulb plate of the centre fore and after is to be extended to the top of the wood covers.

HATCH WEBS.

TABLE B.

TABLE 36 *(Concluded.)*

HATCHWAY BEAMS.

BREADTH OF HATCHWAY.	WITHOUT FORE AND AFTERS. Spacing Centre to Centre.		WITH FORE AND AFTERS. Spacing Centre to Centre.			ANGLES ON EDGES OF WEBS.
	Feet. 4	Feet. 5	Feet. 6	Feet. 8	Feet. 10	
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	8 ×·40 B.P.	9 ×·44 B.P.	9½ ×·46 B.P.	10½ ×·50 B.P.	11½ ×·52 B.P.	3 × 3 ×·40
12	9 ×·44 B.P.	10 ×·50 B.P.	11 ×·50 B.P.	11 ×·30	13 ×·34	3 × 3 ×·40
14	10 ×·50 B.P.	11½ ×·50 B.P.	11 ×·30	13 ×·32	15 ×·34	3 × 3 ×·42
16	11 ×·30	11 ×·30	12 ×·32	15 ×·34	17 ×·36	3½ × 3 ×·42
18	11 ×·30	12 ×·32	14 ×·34	17 ×·36	19 ×·38	4 × 3 ×·44
20	12 ×·32	13 ×·34	16 ×·36	19 ×·38	21 ×·38	4 × 3 ×·44
22	12½ ×·32	14 ×·34	17 ×·36	20 ×·38	23 ×·40	4½ × 3 ×·46
24	13 ×·34	14½ ×·34	18 ×·36	21 ×·38	25 ×·40	5 × 3½ ×·46
26	13½ ×·34	15 ×·34	19 ×·38	22 ×·38	26 ×·42	5½ × 3½ ×·48
28	14 ×·34	16 ×·36	20 ×·38	23 ×·40	27 ×·42	6 × 3½ ×·50
30	15 ×·34	17 ×·36	21 ×·38	24 ×·40	28 ×·42	6 × 3½ ×·52

The depths are measured from the top edge of uppermost mounting to lower edge of lower mounting at the middle of the beam.
The depth at the ends is to be one half of the depth at the middle, but in no case less than 6 inches.
The larger flanges of the mounting angles are to be fitted horizontally.

CENTRE FORE AND AFTERS.†

LENGTH OF FORE AND AFTER.	STEEL BULB PLATE. Spacing of Fore and Afters.			DOUBLE ANGLES ON UPPER EDGE.	WOOD. Spacing of Fore and Afters.					
	Feet. 3	Feet. 4	Feet. 5		Feet. 3		Feet. 4		Feet. 5	
Feet.	Inches.	Inches.	Inches.	Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.
6	5 ×·34	5½ ×·34	6 ×·36	2½ × 2½ ×·36	5	7	5½	7	6	7
8	6 ×·38	7 ×·40	7½ ×·42	2½ × 2½ ×·38	6	7	6½	7	7	7
10	7 ×·44	8 ×·46	9 ×·50	2½ × 2½ ×·40	7	7	7½	7	8	7

SIDE FORE AND AFTERS.†

LENGTH OF FORE AND AFTER.	STEEL BULB ANGEL. Spacing of Fore and Afters.			ANGLE ON UPPER EDGE OF BULB ANGLE.	WOOD. Spacing of Fore and Afters.					
	Feet. 3	Feet. 4	Feet. 5		Feet. 3		Feet. 4		Feet. 5	
Feet.	Inches.	Inches.	Inches.	Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.	Depth. Inches.	Breadth. Inches.
6	5 × 3 ×·34	5½ × 3 ×·34	6 × 3 ×·36	2½ × 2½ ×·36	5	5	5½	5	6	5
8	6 × 3 ×·38	7 × 3 ×·40	7½ × 3½ ×·42	2½ × 2½ ×·38	6	5	6½	6	7	6
10	7 × 3 ×·44	8 × 3½ ×·46	9 × 3½ ×·50	2½ × 2½ ×·40	7	6	7½	7	8	7

† Depths of fore and afters are measured to under side of covers, and the bulb plate of the centre fore and after is to be extended to the top of the wood covers.

LLOYD'S REGISTER OF SHIPPING, LONDON.—28*th October*, 1932.

EQUIVALENT SECTIONS in ASSOCIATION with PLATING. TABLE 37

ANGLES.	ANGLES.	BULB ANGLES.	BULB ANGLES.	CHANNELS.	CHANNELS.	CHANNELS.	CHANNELS.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3 ×3×·40	3½×3×·30						
3½×3×·40	4 ×3×·32						
4 ×3×·40	4½×3×·32						
4½×3×·40	5 ×3×·32						
5 ×3×·40	5½×3×·32						
5½×3×·40	6 ×3×·34						
6 ×3×·40	6½×3×·34		5 ×3 ×·32				
6½×3×·40			5½×3 ×·32				
		5½×3 ×·44	6 ×3 ×·32				
		6 ×3 ×·44	6½×3 ×·32				
		6½×3 ×·46	7 ×3 ×·32				
		7 ×3 ×·48	7½×3 ×·34			6 ×3×3×·34	
		7½×3 ×·50	8 ×3½×·36	6 ×3½×3½×·42	6½×3½×3½×·32	6½×3×3×·40	7 ×3×3×·30
		8 ×3½×·50	8½×3½×·38	6½×3½×3½×·42	7 ×3½×3½×·32	7 ×3×3×·44	7½×3×3×·34
		8½×3½×·52	9 ×3½×·40	7 ×3½×3½×·48	7½×3½×3½×·36	7½×3×3×·46	8 ×3×3×·36
		9 ×3½×·54	9½×3½×·42	7½×3½×3½×·52	8 ×3½×3½×·40	8 ×3×3×·50	8½×3×3×·40
		9½×3½×·54	10 ×3½×·42	8 ×3½×3½×·54	8½×3½×3½×·42	8½×3×3×·52	9 ×3×3×·42
		10 ×3½×·54	10½×3½×·42	8½×3½×3½×·56	9 ×3½×3½×·46	9 ×3×3×·56	
		10½×3½×·54	11 ×3½×·42	9 ×3½×3½×·58	9½×3½×3½×·48		
		11 ×3½×·56	11½×3½×·44	9½×3½×3½×·62	10 ×3½×3½×·52		
		11½×3½×·56	12 ×3½×·46	10½×3½×3½×·56	11 ×3½×3½×·48		
		12 ×3½×·56		11 ×3½×3½×·56	11½×3½×3½×·48		
				12 ×3½×3½×·56	11½×3½×3½×·64		

DIAMETERS and SPACING of RIVETS and BREADTHS of BUTT STRAPS, END LAPS and SEAMS. TABLE 38

Thickness of PLATES	Inches. Not exceeding ·36	Inches. Above ·36 and not exceeding ·50	Inches. Above ·50 and not exceeding ·72	Inches. Above ·72 and not exceeding ·94	Inches. Above ·94 and not exceeding 1·14	Inches. Above 1·14 to 1·26
Diameter of RIVETS	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$
Breadth of QUADRUPLE riveted BUTT STRAPS in inches	—	—	22	25	$28\frac{1}{4}$	$31\frac{1}{2}$
Breadth of TREBLE riveted BUTT STRAPS in inches	—	$14\frac{1}{4}$	$16\frac{3}{4}$	19	$21\frac{1}{2}$	24
Breadth of DOUBLE riveted BUTT STRAPS in inches	8	$9\frac{3}{4}$	$11\frac{1}{4}$	—	—	—
Breadth of SINGLE riveted BUTT STRAPS in inches	$4\frac{1}{2}$	$5\frac{1}{4}$	—	—	—	—
Breadth of QUINTUPLE riveted END LAPS in inches	—	—	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$
Breadth of QUADRUPLE riveted END LAPS in inches	—	—	12	14	16	18
Breadth of TREBLE riveted END LAPS in inches	6	$7\frac{1}{2}$	9	$10\frac{1}{2}$	12	$13\frac{1}{2}$
Breadth of DOUBLE riveted END LAPS in inches	$4\frac{1}{4}$	5	6	—	—	—
Breadth of SINGLE riveted END LAPS in inches	$2\frac{1}{2}$	3	—	—	—	—
Breadth of TREBLE riveted SEAMS in inches	—	—	—	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$
Breadth of DOUBLE riveted SEAMS in inches	$3\frac{3}{4}$	$4\frac{1}{2}$	$5\frac{1}{4}$	6	$6\frac{3}{4}$	$7\frac{1}{2}$
Breadth of SINGLE riveted SEAMS in inches	$2\frac{1}{4}$	$2\frac{1}{2}$	3	—	—	—
MAXIMUM SPACING FROM CENTRE TO CENTRE. $3\frac{1}{2}$ diam. c. to c. — End Laps of Shell Plating where thickness does not exceed ·36 inch	$2\frac{1}{4}$	$2\frac{5}{8}$	$3\frac{1}{8}$	$3\frac{1}{2}$	4	$4\frac{3}{8}$
4 diam. c. to c. — End Laps of Shell Plating, where thickness exceeds ·36 inch (except Quintuple Riveted Laps); End Laps of Strength Deck Stringer Plates and Plating for $\frac{1}{2}$L amidships; Double Butt Straps, End Laps and Seams of Inner Bottom Plating, including Margin Plate; End Laps of Girders and Tee Plates	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
$4\frac{1}{2}$ diam. c. to c. — Seams of Shell Plating (forward and aft); Quintuple Riveted End Laps; End Laps of Strength Deck Stringer Plates and Plating at ends; End Laps of Lower Deck Stringer Plates and Plating; Seams of Deck Plating; Margin Plate Angles; Seams and End Connections of Bulkhead and Tunnel Plating; Angles connecting Side Stringers to Web Frames; Flange of W.T. Bulkhead Frames to Bulkhead.	$2\frac{3}{4}$	$3\frac{3}{8}$	4	$4\frac{1}{2}$	—	—
5 diam. c. to c. — Flat Keel Angles; Vertical Angles connecting Floors and Centre Girder; Flange of W.T. Bulkhead Frames to Shell, Deck and Inner Bottom; End Connections and Edges of Mast Plates; Floors and Cross Ties in After Peak.	$3\frac{1}{8}$	$3\frac{3}{4}$	$4\frac{3}{8}$	5	$5\frac{5}{8}$	$6\frac{1}{4}$
$5\frac{1}{2}$ diam. c. to c. — Hold Frames where spacing exceeds $34\frac{1}{2}$ inches; Frames in Panting Area; Frames in Deep and Peak Tanks; Frames connecting Floors to Shell Plating (both flanges) forward of the half Midship Length	$3\frac{1}{2}$	$4\frac{1}{8}$	$4\frac{7}{8}$	$5\frac{1}{2}$	$6\frac{1}{8}$	$6\frac{7}{8}$
6 diam. c. to c. — Hold Frames where spacing exceeds $31\frac{1}{2}$ inches but does not exceed $34\frac{1}{2}$ inches; Bottom Frames to Shell Plating, where spacing exceeds $34\frac{1}{2}$ inches; Beams at alternate Frames; Bulkhead Stiffeners in Deep and Peak Tanks.	$3\frac{3}{4}$	$4\frac{1}{3}$	$5\frac{1}{4}$	—	—	—
$6\frac{1}{2}$ diam. c. to c. — Hold Frames where spacing exceeds $28\frac{1}{2}$ inches but does not exceed $31\frac{1}{2}$ inches; Bottom Frames to Shell Plating where spacing exceeds $31\frac{1}{2}$ inches but does not exceed $34\frac{1}{2}$ inches	4	$4\frac{7}{8}$	$5\frac{3}{4}$	$6\frac{1}{2}$	—	—
7 diam. c. to c. — Hold Frames where spacing does not exceed $28\frac{1}{2}$ inches; Frames in 'Tween Decks; Bottom Frames to Shell Plating where spacing does not exceed $31\frac{1}{2}$ inches; Bottom Frames to Floors; Reversed Frames to Floors and Inner Bottom; Longitudinal Angles on Continuous Girders; Vertical Angles connecting Floors and Side Girders; Floors, Keelsons, Beams except where fitted on Alternate Frames; Deck and Hold Stringer Angles; Face Angles on Web Frames and Side Stringers; Bulkhead Stiffeners except in Deep and Peak Tanks; Angles on Hatch Webs..	$4\frac{1}{2}$	$5\frac{1}{4}$	$6\frac{1}{4}$	7	—	—

RIVETING OF END LAPS AND SEAMS. TABLE 39

ITEM.	THICKNESS OF PLATES IN INCHES.								
	Not exceeding ·36	Above ·36 and not exceeding ·42	Above ·42 and not exceeding ·48	Above ·48 and not exceeding ·54	Above ·54 and not exceeding ·68	Above ·68 and not exceeding ·76	Above ·76 and not exceeding ·84	Above ·84 and not exceeding 1·04	Above 1·04 and not exceeding 1·26
A	Double	Double	Treble	Treble	Treble	Quadruple	Quadruple	Quintuple	Quintuple
B	Double	Double	Treble	Treble	Treble	Quadruple	Quadruple	Quadruple	Quadruple
C	Double	Double	Double	Treble	Treble	Quadruple	Quadruple	Quadruple	
D	Single	Single	Double	Double	Treble	Quadruple	Quadruple	Quadruple	
E	Single	Double	Double	Double	Double	Double	Double	Double	
F	Single	Single	Double	Double	Double	Double	Double	Treble	
G	Single	Single	Single	Single	Single	Single	Double		
H	Single	Single	Single	Double	Double	Double	Double		

The diameter of the rivets used for attachments is to be regulated generally by the greater thickness of the parts to be connected.

Treble riveted double butt straps may be fitted as an alternative to the quintuple riveted end laps required by the Table.

RIVETING REQUIREMENTS FOR END LAPS.

A

Sheerstrake for $\frac{1}{2}$L amidships.

Strength deck stringer plates for $\frac{1}{2}$L amidships.

Shell plating from keel to upper turn of bilge for $\frac{1}{2}$L amidships.

Boss plates.

B

Sheerstrake at ends.

Strength deck stringer plates at ends.

Shell plating from keel to upper turn of bilge at ends.

Shell plating from upper turn of bilge to sheerstrake.

Keel plates.

Lower deck stringer plates.

Deck tie plates.

Keelson, rider and foundation plates.

Floor plates and web frames.

C

Deck plating for $\frac{1}{2}$L amidships.

Inner bottom plating for $\frac{1}{2}$L amidships.

Margin plates.

Middle line strake of inner bottom.

Centre and side girders in double bottom.

D

Deck plating at ends.

Inner bottom plating at ends.

RIVETING REQUIREMENTS FOR SEAMS.

E

Shell plating from keel to upper turn of bilge.

F

Shell plating from upper turn of bilge to sheerstrake.

G

Deck plating.

H

Inner bottom plating.

The seams of shell plating, all fore and aft, are to be regulated by the thickness of plating amidships.

The seams of sheerstrakes, stringer plates and middle line strakes of inner bottom plating may be as required for side shell, deck, and inner bottom plating respectively.

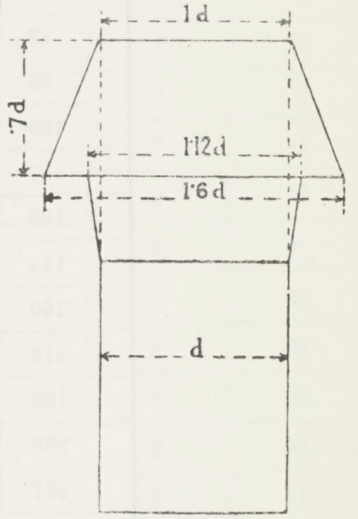
The riveting of seams of shell plating in vessels above 500 feet in length is to be in accordance with **Section 30, clause 5** (*c*).

LLOYD'S REGISTER OF SHIPPING, LONDON.—15*th February*, 1945.

Number of RIVETS in SEAMS of PLATING between FRAMES and BEAMS AMIDSHIPS excluding RIVETS in FRAMES and BEAMS. TABLE 40

SPACING OF FRAMES IN INCHES.	THICKNESS OF SHELL AND DECK PLATING IN INCHES.						THICKNESS OF INNER BOTTOM PLATING IN INCHES.		
	Not exceeding ·36	Above ·36 and not exceeding ·50	Above ·50 and not exceeding ·72	Above ·72 and not exceeding ·94	Above ·94 and not exceeding 1·14	Above 1·14 to 1·26	Not exceeding ·36	Above ·36 and not exceeding ·50	Above ·50 and not exceeding ·72
	Diameter of Rivet in inches.						Diameter of Rivet in inches.		
	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
	Number of Rivets in each Row.						Number of Rivets in each Row.		
20	7*	5					7	6	
$20\frac{1}{2}$	7	5					7	6	
21	7	6*	5				7	6	5
$21\frac{1}{2}$	7	6	5				7	6	5
22	7	6	5				8	6	5
$22\frac{1}{2}$	7	6	5				8	6	5
23	8*	7*	5	5			8	7	6
$23\frac{1}{2}$		7*	5	5			8	7	6
24		7*	6*	5			8	7	6
$24\frac{1}{2}$		7*	6*	5			9	7	6
25		7	6	5			9	7	6
$25\frac{1}{2}$		7	6	5				7	7
26		7	6	5	5			8	7
$26\frac{1}{2}$		7	6	5	5			8	7
27		8*	7*	6*	5			8	7
$27\frac{1}{2}$		8*	7*	6*	5			8	7
28		8*	7*	6*	5	5		8	7
$28\frac{1}{2}$		8	7*	6	5	5		8	7
29		8	7	6	5	5			8
$29\frac{1}{2}$		8	7	6	5	5			8
30		8	7	6	5	5			8
$30\frac{1}{2}$		8	7	6	6*	5			8
31		9	7	6	6*	5			8
$31\frac{1}{2}$			7	6	6	5			8
32			8*	7*	6	5			8
$32\frac{1}{2}$			8*	7*	6	5			8
33			8	7	6	5			9
$33\frac{1}{2}$			8	7	6	5			9
34			8	7	6	6			9
$34\frac{1}{2}$			8	7	6	6			9
35			8	7	6	6			9
$35\frac{1}{2}$			8	7	7*	6			9
36			8	7	7*	6			9

STANDARD FORM OF RIVET.



The tapered neck of Rivet to be of suitable length in relation to the thickness of plate in which it is intended to be used.

The number of rivets in deck seams may be reduced by one where indicated thus *.

DIAMETERS of RUDDER HEADS. TABLE 41

A × D	SPEED OF VESSEL IN NAUTICAL MILES PER HOUR.					
	12 AND BELOW.	14	16	18	20	22
	DIAMETER OF RUDDER HEAD.					
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
28	3	3¼	3½	4	4½	5
34	3¼	3½	3¾	4¼	4¾	5¼
40	3½	3¾	4	4½	5	5½
47	3¾	4	4½	5	5½	6
55	4	4¼	4¾	5¼	5¾	6¼
64	4¼	4½	5	5½	6	6½
73	4½	4¾	5¼	5¾	6¼	6¾
83	4¾	5	5½	6	6½	7
94	5	5½	6	6½	7	7½
105	5¼	5¾	6¼	6¾	7¼	7¾
117	5½	6	6½	7	7½	8
130	5¾	6¼	6¾	7¼	7¾	8¼
144	6	6½	7	7½	8	8½
160	6¼	6¾	7¼	7¾	8¼	9
176	6½	7	7½	8	8½	9¼
192	6¾	7¼	7¾	8¼	8¾	9½
209	7	7½	8	8½	9¼	10
227	7¼	7¾	8¼	8¾	9½	10¼
246	7½	8	8½	9	9¾	10½
268	8	8½	9	9½	10	10¾
290	8½	9	9½	10	10½	11¼
335	9	9½	10	10½	11	11¾
390	9½	10	10½	11	11½	12½
445	10	10½	11	11½	12	13
505	10½	11	11½	12	13	14
570	11	11½	12	12½	13½	14½
640	11½	12	12½	13½	14½	15½
720	12	12½	13	14	15	16
800	12½	13	13½	14½	15½	16½
890	13	13½	14	15	16	17
980	13½	14	14½	15½	16½	17½
1080	14	14½	15½	16½	17½	18½
1180	14½	15	16	17	18	19
1290	15	15½	16½	17½	18½	19½
1400	15½	16	17	18	19	20

In Tugs the diameter of the rudder head is to be increased ½ inch beyond that given in the Table, and all Scantlings of the rudder are to be in accordance with the increased diameter.

LLOYD'S REGISTER OF SHIPPING, LONDON.—*8th April*, 1937.

COUPLINGS of RUDDER HEADS. TABLE 42

DIAMETER OF RUDDER HEAD AS PER TABLE 41.	HORIZONTAL COUPLING. 6 Bolts.		VERTICAL COUPLING. 8 Bolts.		SCARPHED COUPLING.					
					Length of Scarph.	Width of Scarphs.		Bolts.		
						At Top.	At Bottom.	Number.		Diameter.
	Mean Distance of Centres of Bolts from Centre of Coupling.	Diameter of Bolts and Thickness of Flanges.	Width of Coupling.	Diameter of Bolts and Thickness of Flanges.				Total.	In Top Row.	
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.			Inches.
$4\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{3}{8}$	12	$1\frac{3}{8}$	$13\frac{1}{2}$	9	15	6	2	$1\frac{1}{2}$
$4\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{3}{8}$	12	$1\frac{3}{8}$	$13\frac{1}{2}$	9	15	6	2	$1\frac{1}{2}$
5	$4\frac{1}{2}$	$1\frac{3}{8}$	12	$1\frac{3}{8}$	$13\frac{1}{2}$	9	15	6	2	$1\frac{1}{2}$
$5\frac{1}{4}$	$4\frac{3}{4}$	$1\frac{3}{8}$	12	$1\frac{3}{8}$	$13\frac{1}{2}$	9	15	6	2	$1\frac{1}{2}$
$5\frac{1}{2}$	5	$1\frac{3}{8}$	$12\frac{1}{2}$	$1\frac{3}{8}$	14	$9\frac{1}{2}$	$15\frac{1}{2}$	6	2	$1\frac{5}{8}$
$5\frac{3}{4}$	$5\frac{1}{4}$	$1\frac{1}{2}$	13	$1\frac{1}{2}$	$14\frac{1}{2}$	10	16	6	2	$1\frac{3}{4}$
6	$5\frac{1}{2}$	$1\frac{5}{8}$	$13\frac{1}{2}$	$1\frac{5}{8}$	15	$10\frac{1}{2}$	$16\frac{1}{2}$	6	2	$1\frac{7}{8}$
$6\frac{1}{4}$	$5\frac{3}{4}$	$1\frac{3}{4}$	14	$1\frac{3}{4}$	$15\frac{3}{4}$	11	$17\frac{1}{4}$	6	2	2
$6\frac{1}{2}$	6	$1\frac{7}{8}$	$14\frac{1}{2}$	$1\frac{7}{8}$	$16\frac{1}{4}$	$11\frac{1}{2}$	18	6	2	$2\frac{1}{8}$
$6\frac{3}{4}$	$6\frac{1}{4}$	$1\frac{7}{8}$	15	$1\frac{7}{8}$	17	12	$18\frac{3}{4}$	6	2	$2\frac{1}{8}$
7	$6\frac{1}{2}$	2	$15\frac{3}{4}$	2	$17\frac{1}{2}$	$12\frac{1}{4}$	$19\frac{1}{2}$	6	2	$2\frac{1}{4}$
$7\frac{1}{4}$	$6\frac{3}{4}$	$2\frac{1}{8}$	$16\frac{1}{4}$	$2\frac{1}{8}$	18	$12\frac{3}{4}$	20	6	2	$2\frac{1}{4}$
$7\frac{1}{2}$	7	$2\frac{1}{8}$	$16\frac{3}{4}$	$2\frac{1}{8}$	$18\frac{3}{4}$	$13\frac{1}{4}$	21	7	2	$2\frac{1}{8}$
$7\frac{3}{4}$	$7\frac{1}{4}$	$2\frac{1}{4}$	$17\frac{1}{4}$	$2\frac{1}{4}$	$19\frac{1}{2}$	$13\frac{1}{2}$	$21\frac{1}{2}$	7	2	$2\frac{1}{8}$
8	$7\frac{1}{2}$	$2\frac{3}{8}$	18	$2\frac{3}{8}$	20	14	22	7	2	$2\frac{1}{4}$
$8\frac{1}{2}$	$7\frac{3}{4}$	$2\frac{1}{2}$	19	$2\frac{1}{2}$	$21\frac{1}{4}$	15	24	7	2	$2\frac{1}{2}$
9	$8\frac{1}{4}$	$2\frac{3}{4}$	20	$2\frac{3}{4}$	$22\frac{1}{2}$	$15\frac{3}{4}$	25	7	2	$2\frac{5}{8}$
$9\frac{1}{2}$	$8\frac{1}{2}$	$2\frac{7}{8}$	$21\frac{1}{4}$	$2\frac{7}{8}$	$23\frac{3}{4}$	$16\frac{3}{4}$	26	7	2	$2\frac{3}{4}$
10	9	3	$22\frac{1}{2}$	3	25	$17\frac{1}{2}$	$27\frac{1}{2}$	7	2	$2\frac{7}{8}$
$10\frac{1}{2}$	$9\frac{1}{2}$	$3\frac{1}{8}$	$23\frac{1}{2}$	$3\frac{1}{8}$	$26\frac{1}{4}$	$18\frac{1}{2}$	29	8	2	$2\frac{7}{8}$
11	10	$3\frac{1}{4}$	$24\frac{3}{4}$	$3\frac{1}{4}$	$27\frac{1}{2}$	$19\frac{1}{4}$	30	8	2	3
$11\frac{1}{2}$	$10\frac{1}{2}$	$3\frac{3}{8}$	26	$3\frac{3}{8}$	$28\frac{3}{4}$	$20\frac{1}{4}$	$31\frac{1}{2}$	8	2	$3\frac{1}{8}$
12	$10\frac{3}{4}$	$3\frac{1}{2}$	27	$3\frac{1}{2}$	30	21	33	8	2	$3\frac{1}{4}$
$12\frac{1}{2}$	$11\frac{1}{4}$	$3\frac{5}{8}$	28	$3\frac{5}{8}$	$31\frac{1}{4}$	25	$34\frac{1}{2}$	9	3	$3\frac{1}{4}$
13	$11\frac{3}{4}$	$3\frac{3}{4}$	29	$3\frac{3}{4}$	$32\frac{1}{2}$	26	36	9	3	$3\frac{1}{4}$
$13\frac{1}{2}$	$12\frac{1}{4}$	$3\frac{7}{8}$	30	$3\frac{7}{8}$	$33\frac{3}{4}$	27	$37\frac{1}{2}$	9	3	$3\frac{3}{8}$
14	$12\frac{3}{4}$	4	$31\frac{1}{2}$	4	35	28	39	9	3	$3\frac{5}{8}$
$14\frac{1}{2}$	13	$4\frac{1}{8}$	$32\frac{1}{2}$	$4\frac{1}{8}$	$36\frac{1}{4}$	29	40	9	3	$3\frac{3}{4}$
15	$13\frac{1}{2}$	$4\frac{1}{4}$	$33\frac{1}{2}$	$4\frac{1}{4}$	$37\frac{1}{2}$	30	41	9	3	$3\frac{7}{8}$

SINGLE PLATE RUDDERS. TABLE 43

Diameter of Rudder Head as per Table 41.	Diameter of Pintles.	Diameter of Mainpiece at Heel.	ARM AT EACH PINTLE KEYED TO MAINPIECE.						ARM AT AND BETWEEN RUDDER PINTLES.								Diameter of Rivets spaced 4½ Diameters apart Centre to Centre.
			Arm at Mainpiece.		Thickness of Arm round Mainpiece.	Thickness of Arm at Point.	Maximum Distance between Centre of Arms.	Thickness of Plate.	Keyed to Mainpiece.			Forged to Mainpiece.		Thickness of Arm at Point.	Maximum Distance between Centre of Arms.	Thickness of Plate.	
			Breadth.	Thickness.					Arm at Mainpiece.		Thickness of Arm round Mainpiece.	Breadth of Arms.					
									Breadth.	Thickness.		With Small Fillet.	With Large Fillet.				
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
2¾	2	2¼	2¾	1⅞	1¼	¾	45	·74	2¾	1½	1⅛	5	4½	¾	26	·50	⅞
3	2	2½	3	2	1⅜	¾	45	·74	3	1½	1⅛	5	4½	¾	26	·50	⅞
3¼	2¼	2¾	3¼	2⅛	1⅜	¾	46	·76	3¼	1½	1⅛	5	4½	¾	26	·50	⅞
3½	2¼	2¾	3½	2¼	1½	¾	46	·76	3½	1⅝	1⅛	5	4½	¾	26	·52	⅞
3¾	2½	3	3¾	2⅜	1⅝	¾	47	·78	3¾	1¾	1¼	5	4½	¾	26	·52	1
4	2½	3	4	2½	1¾	⅞	48	·80	4	1⅞	1⅜	5½	4½	⅞	27	·54	1
4¼	2¾	3¼	4¼	2⅝	1⅞	⅞	49	·80	4¼	1⅞	1⅜	5½	4½	⅞	27	·54	1
4½	2¾	3½	4½	2¾	2	⅞	50	·82	4½	2	1⅜	5½	4½	⅞	27	·56	1
4¾	2¾	3½	4¾	2⅞	2	⅞	51	·84	4¾	2⅛	1½	5½	4½	⅞	27	·56	1
5	3	3¾	5	3	2⅛	1	52	·86	5	2⅛	1½	5½	4½	1	28	·58	1⅛
5¼	3	4	5¼	3⅛	2¼	1	53	·88	5	2¼	1½	5½	4½	1	28	·58	1⅛
5½	3	4¼	5½	3⅛	2¼	1	54	·90	5¼	2¼	1½	6	5	1	28	·60	1⅛
5¾	3	4¼	5¾	3¼	2⅜	1	54	·90	5½	2⅜	1⅝	6	5	1	28	·60	1⅛
6	3	4½	6	3⅜	2⅜	1	55	·92	5½	2⅜	1⅝	6	5	1	29	·62	1⅛
6¼	3¼	4¾	6¼	3⅜	2⅜	1	56	·94	5¾	2⅜	1⅝	6	5	1	29	·64	1⅛
6½	3¼	4⅞	6½	3½	2½	1	57	·94	5¾	2½	1¾	6	5	1	29	·66	1⅛
6¾	3½	5	6¾	3½	2½	1	58	·96	6	2⅝	1⅞	6	5	1	29	·66	1⅛
7	3½	5¼	7	3⅝	2½	1	59	·98	6	2¾	2	6	5	1	30	·68	1⅛
7¼	3½	5½	7¼	3⅝	2⅝	1	60	1·00	6	2¾	2	6	5	1	30	·68	1⅛
7½	3¾	5½	7½	3¾	2⅝	1	61	1·00	6	2⅞	2⅛	6	5	1	30	·70	1⅛
7¾	3¾	5¾	7¾	3⅞	2¾	1	61	1·00	6¼	3	2⅛	6	5	1	30	·70	1⅛
8	4	6	8	4	2¾	1	62	1·02	6¼	3⅛	2¼	6	5	1	31	·72	1¼
8½	4¼	6½	8½	4¼	3	1⅛	63	1·04	6¼	3¼	2¼	6½	5½	1⅛	31	·72	1¼
9	4½	6¾	9	4⅜	3	1⅛	63	1·04	6¼	3½	2½	6½	5½	1⅛	32	·74	1¼
9½	4¾	7¼	9½	4½	3⅛	1⅛	64	1·06	6½	3⅞	2¾	6½	5½	1⅛	32	·76	1¼
10	5	7½	10	4⅝	3¼	1⅛	65	1·08	6½	4⅛	2⅞	6½	5½	1⅛	33	·78	1¼
10½	5¼	8	10½	4¾	3⅜	1⅛	66	1·10	6½	4¼	3	6½	5½	1⅛	33	·80	1¼
11	5½	8¼	11	5	3½	1⅛	67	1·10	6¾	4⅜	3⅛	7	6	1⅛	34	·82	1¼
11½	5¾	8½	11½	5¼	3⅝	1⅛	68	1·12	6¾	4½	3¼	7	6	1⅛	34	·82	1¼
12	6	9	12	5⅜	3⅝	1⅛	69	1·12	7	4⅝	3⅜	7	6	1⅛	35	·84	1¼
12½	6¼	9½	12½	5½	3¾	1⅛	70	1·14	7¼	4¾	3½	7	6	1⅛	35	·84	1¼
13	6½	9¾	13	5½	3¾	1⅛	71	1·14	7½	4⅞	3½	7	6	1⅛	36	·86	1¼
13½	6¾	10¼	13½	5⅝	3⅞	1⅛	72	1·16	7¾	5	3⅝	7½	6½	1⅛	36	·86	1¼
14	6¾	10½	14	5⅝	3⅞	1⅛	73	1·16	8	5⅛	3⅝	7½	6½	1⅛	37	·88	1¼
14½	7	11	14½	5¾	4	1⅛	74	1·18	8¼	5¼	3¾	7½	6½	1⅛	37	·88	1¼
15	7	11¼	15	5¾	4	1⅛	75	1·18	8½	5⅜	3¾	7½	6½	1⅛	38	·90	1¼

DOUBLE PLATE RUDDERS. TABLE 44

DIAMETER OF RUDDER HEAD AS PER TABLE 41.	DIAMETER OF PINTLES.	SECTION OF MAINPIECE AT HEEL.	MINIMUM DIMENSIONS OF BOW AND STAYS.	THICKNESS OF PLATES.	DIAMETER OF RIVETS SPACED 5 DIAMETERS APART FROM CENTRE TO CENTRE.
Inches.	Inches.	Inches. *	Inches.	Inches.	Inches.
$2\frac{3}{4}$	2	2 × $1\frac{3}{4}$	2 × $\frac{7}{8}$	·24	$\frac{3}{4}$
3	2	2 × 2	2 × $\frac{7}{8}$	·24	$\frac{3}{4}$
$3\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$ × 2	$2\frac{1}{4}$ × $\frac{7}{8}$	·24	$\frac{3}{4}$
$3\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{2}$ × 2	$2\frac{1}{4}$ × $\frac{7}{8}$	·26	$\frac{3}{4}$
$3\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$ × $2\frac{1}{4}$	$2\frac{1}{2}$ × $\frac{7}{8}$	·26	$\frac{3}{4}$
4	$2\frac{1}{2}$	$2\frac{3}{4}$ × $2\frac{1}{4}$	$2\frac{1}{2}$ × 1	·26	$\frac{3}{4}$
$4\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$ × $2\frac{1}{2}$	$2\frac{1}{2}$ × 1	·26	$\frac{3}{4}$
$4\frac{1}{2}$	$2\frac{3}{4}$	3 × $2\frac{3}{4}$	$2\frac{1}{2}$ × $1\frac{1}{8}$	·28	$\frac{3}{4}$
$4\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$ × $2\frac{3}{4}$	$2\frac{3}{4}$ × $1\frac{1}{8}$	·28	$\frac{3}{4}$
5	3	$3\frac{1}{4}$ × 3	$2\frac{3}{4}$ × $1\frac{1}{4}$	·28	$\frac{7}{8}$
$5\frac{1}{4}$	3	$3\frac{1}{2}$ × 3	$2\frac{3}{4}$ × $1\frac{1}{4}$	·28	$\frac{7}{8}$
$5\frac{1}{2}$	3	4 × 3	$2\frac{3}{4}$ × $1\frac{3}{8}$	·30	$\frac{7}{8}$
$5\frac{3}{4}$	3	$4\frac{1}{4}$ × 3	3 × $1\frac{3}{8}$	·30	$\frac{7}{8}$
6	3	$4\frac{1}{2}$ × 3	3 × $1\frac{1}{2}$	·30	$\frac{7}{8}$
$6\frac{1}{4}$	$3\frac{1}{4}$	$4\frac{3}{4}$ × $3\frac{1}{4}$	3 × $1\frac{1}{2}$	·30	$\frac{7}{8}$
$6\frac{1}{2}$	$3\frac{1}{4}$	5 × $3\frac{1}{4}$	3 × $1\frac{5}{8}$	·32	$\frac{7}{8}$
$6\frac{3}{4}$	$3\frac{1}{2}$	$5\frac{1}{4}$ × $3\frac{1}{2}$	$3\frac{1}{4}$ × $1\frac{5}{8}$	·32	$\frac{7}{8}$
7	$3\frac{1}{2}$	$5\frac{1}{2}$ × $3\frac{1}{2}$	$3\frac{1}{4}$ × $1\frac{3}{4}$	·32	$\frac{7}{8}$
$7\frac{1}{4}$	$3\frac{1}{2}$	6 × $3\frac{1}{2}$	$3\frac{1}{2}$ × $1\frac{3}{4}$	·34	$\frac{7}{8}$
$7\frac{1}{2}$	$3\frac{3}{4}$	$6\frac{1}{4}$ × $3\frac{3}{4}$	$3\frac{1}{2}$ × $1\frac{7}{8}$	·34	$\frac{7}{8}$

* The figures in this column are to be the fore and aft dimensions.

STEERING CHAINS, RODS, QUADRANTS and TILLERS. TABLE 45

DIAMETER OF RUDDER HEAD AS PER TABLE 41	RADIUS OF QUADRANT.	Diameter of Chains.	Diameter of Rods.	BOSS OF QUADRANT.		QUADRANTS AND TILLERS.		
				Depth.	Outside Diameter.	Sizes of Arms at Twice the Diameter of Rudder Head from Centre of Rudder Head.		
						One Arm.	Two Arms.	Three Arms.
Inches.	Feet. Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
$2\frac{3}{4}$	2—10	$\frac{3}{8}$	$\frac{1}{2}$	$2\frac{3}{4}$	$5\frac{1}{4}$	$3\frac{1}{4} \times 1\frac{7}{8}$		
3	3— 0	$\frac{7}{16}$	$\frac{1}{2}$	3	$5\frac{1}{2}$	$3\frac{1}{4} \times 2$		
$3\frac{1}{4}$	3— 0	$\frac{1}{2}$	$\frac{9}{16}$	$3\frac{1}{4}$	$5\frac{3}{4}$	$3\frac{1}{4} \times 2\frac{1}{4}$		
$3\frac{1}{2}$	3— 2	$\frac{9}{16}$	$\frac{5}{8}$	$3\frac{1}{2}$	$6\frac{1}{4}$	$3\frac{1}{2} \times 2\frac{1}{2}$		
$3\frac{3}{4}$	3— 2	$\frac{9}{16}$	$\frac{5}{8}$	$3\frac{3}{4}$	$6\frac{3}{4}$	$4 \times 2\frac{1}{2}$		
4	3— 4	$\frac{5}{8}$	$\frac{11}{16}$	4	$7\frac{1}{4}$	$4\frac{1}{4} \times 2\frac{1}{2}$		
$4\frac{1}{4}$	3— 4	$\frac{11}{16}$	$\frac{3}{4}$	$4\frac{1}{4}$	$7\frac{1}{2}$	$4\frac{1}{2} \times 2\frac{3}{4}$		
$4\frac{1}{2}$	3— 6	$\frac{11}{16}$	$\frac{3}{4}$	$4\frac{1}{2}$	8	$5 \times 2\frac{3}{4}$	$3\frac{3}{4} \times 2\frac{1}{4}$	
$4\frac{3}{4}$	3— 6	$\frac{12}{16}$	$\frac{13}{16}$	$4\frac{3}{4}$	$8\frac{1}{2}$	$5\frac{1}{4} \times 2\frac{3}{4}$	$4 \times 2\frac{1}{4}$	
5	3— 8	$\frac{12}{16}$	$\frac{13}{16}$	5	9	$5\frac{1}{2} \times 3$	$4\frac{1}{4} \times 2\frac{1}{2}$	
$5\frac{1}{4}$	3— 8	$\frac{13}{16}$	$\frac{14}{16}$	$5\frac{1}{4}$	$9\frac{1}{4}$	$5\frac{3}{4} \times 3$	$4\frac{1}{2} \times 2\frac{1}{2}$	
$5\frac{1}{2}$	3—10	$\frac{13}{16}$	$\frac{15}{16}$	$5\frac{1}{2}$	$9\frac{3}{4}$	$6 \times 3\frac{1}{4}$	$4\frac{3}{4} \times 2\frac{1}{2}$	
$5\frac{3}{4}$	3—10	$\frac{7}{8}$	$\frac{15}{16}$	$5\frac{3}{4}$	$10\frac{1}{4}$	$6\frac{1}{4} \times 3\frac{1}{4}$	$5 \times 2\frac{1}{2}$	
6	4— 0	$\frac{7}{8}$	1	6	$10\frac{3}{4}$	$6\frac{1}{2} \times 3\frac{1}{2}$	$5\frac{1}{4} \times 2\frac{3}{4}$	
$6\frac{1}{4}$	4— 0	$\frac{15}{16}$	$1\frac{1}{16}$	$6\frac{1}{4}$	$11\frac{1}{4}$	$6\frac{3}{4} \times 3\frac{1}{2}$	$5\frac{1}{2} \times 2\frac{3}{4}$	
$6\frac{1}{2}$	4— 2	$\frac{15}{16}$	$1\frac{1}{16}$	$6\frac{1}{2}$	$11\frac{3}{4}$	$7 \times 3\frac{3}{4}$	$5\frac{1}{2} \times 3$	
$6\frac{3}{4}$	4— 2	1	$1\frac{1}{8}$	$6\frac{3}{4}$	12	$7\frac{1}{4} \times 3\frac{3}{4}$	$5\frac{3}{4} \times 3$	
7	4— 4	1	$1\frac{1}{4}$	7	$12\frac{1}{2}$	$7\frac{1}{2} \times 4$	$6 \times 3\frac{1}{4}$	
$7\frac{1}{4}$	4— 4	$1\frac{1}{16}$	$1\frac{1}{4}$	$7\frac{1}{4}$	13	$7\frac{3}{4} \times 4\frac{1}{4}$	$6 \times 3\frac{1}{4}$	
$7\frac{1}{2}$	4— 6	$1\frac{1}{16}$	$1\frac{5}{16}$	$7\frac{1}{2}$	$13\frac{1}{2}$	$8 \times 4\frac{1}{2}$	$6\frac{1}{4} \times 3\frac{1}{2}$	
$7\frac{3}{4}$	4— 6	$1\frac{1}{8}$	$1\frac{3}{8}$	$7\frac{3}{4}$	14	$8\frac{1}{4} \times 4\frac{1}{2}$	$6\frac{1}{4} \times 3\frac{3}{4}$	
8	4— 8	$1\frac{3}{16}$	$1\frac{3}{8}$	8	$14\frac{1}{2}$	$8\frac{1}{2} \times 4\frac{3}{4}$	$6\frac{1}{2} \times 4$	$5\frac{3}{4} \times 3\frac{1}{2}$
$8\frac{1}{2}$	5— 0	$1\frac{1}{4}$	$1\frac{1}{2}$	$8\frac{1}{2}$	$15\frac{1}{4}$	9×5	7×4	$6 \times 3\frac{3}{4}$
9	5— 4	$1\frac{5}{16}$	$1\frac{9}{16}$	9	$16\frac{1}{4}$	$9\frac{1}{2} \times 5\frac{1}{4}$	$7\frac{1}{2} \times 4\frac{1}{4}$	$6\frac{1}{2} \times 3\frac{3}{4}$
$9\frac{1}{2}$	5— 8	$1\frac{3}{8}$	$1\frac{11}{16}$	$9\frac{1}{2}$	17	$10 \times 5\frac{3}{4}$	$8 \times 4\frac{1}{2}$	7×4
10	6— 0	$1\frac{7}{16}$	$1\frac{3}{4}$	10	18	$10\frac{1}{2} \times 6$	$8\frac{1}{2} \times 4\frac{1}{2}$	$7\frac{1}{2} \times 4$
$10\frac{1}{2}$	6— 4	$1\frac{1}{2}$	$1\frac{7}{8}$	$10\frac{1}{2}$	19	$11 \times 6\frac{1}{4}$	$9 \times 4\frac{3}{4}$	8×4
11	6— 8	$1\frac{9}{16}$	$1\frac{15}{16}$	11	$19\frac{3}{4}$	$11\frac{1}{2} \times 6\frac{3}{4}$	$9\frac{1}{2} \times 5$	$8\frac{1}{4} \times 4\frac{1}{2}$
$11\frac{1}{2}$	7— 4	$1\frac{5}{8}$	2	$11\frac{1}{2}$	$20\frac{3}{4}$	12×7	$10 \times 5\frac{1}{4}$	$8\frac{1}{2} \times 5$
12	8— 0	$1\frac{5}{8}$	2	12	$21\frac{1}{2}$	$12\frac{1}{2} \times 7\frac{1}{2}$	$10\frac{1}{2} \times 5\frac{1}{2}$	9×5
$12\frac{1}{2}$	8— 0			$12\frac{1}{2}$	$22\frac{1}{2}$	$13 \times 7\frac{1}{2}$	$11 \times 5\frac{1}{2}$	$9\frac{1}{2} \times 5$
13	8— 0			13	$23\frac{1}{2}$	$13\frac{1}{2} \times 7\frac{1}{2}$	$11\frac{1}{4} \times 5\frac{3}{4}$	10×5
$13\frac{1}{2}$	8— 0			$13\frac{1}{2}$	$24\frac{1}{2}$	14×8	$11\frac{1}{2} \times 6$	$10 \times 5\frac{1}{4}$
14	8— 0			14	$25\frac{1}{4}$	$14\frac{1}{2} \times 8$	12×6	$10\frac{1}{2} \times 5\frac{1}{4}$
$14\frac{1}{2}$	8— 0			$14\frac{1}{2}$	$26\frac{1}{4}$	$15 \times 8\frac{1}{2}$	$12\frac{1}{4} \times 6\frac{1}{2}$	$10\frac{1}{2} \times 5\frac{1}{2}$
15	8— 0			15	27	$15\frac{1}{2} \times 8\frac{1}{2}$	$12\frac{3}{4} \times 6\frac{1}{2}$	$11 \times 5\frac{1}{2}$

BOLTS for BOLTED TILLERS and QUADRANTS. TABLE 46

Diameter of Rudder Head as per Table 41.	ONE BOLT EACH SIDE.		TWO BOLTS EACH SIDE.		FOUR BOLTS EACH SIDE.			Thickness of Coupling.
	Diameter.	Distance Centre to Centre.	Diameter.	Distance Centre to Centre.	Diameter.	Inner Bolts Centre to Centre.	Outer Bolts Centre to Centre.	
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
4	$1\frac{3}{4}$	12	$1\frac{3}{8}$	11	$\frac{7}{8}$	$9\frac{1}{2}$	15	$1\frac{1}{2}$
$4\frac{1}{2}$	2	13	$1\frac{1}{2}$	12	1	$10\frac{1}{2}$	$16\frac{1}{2}$	$1\frac{5}{8}$
5	$2\frac{1}{4}$	14	$1\frac{3}{4}$	13	$1\frac{1}{8}$	$11\frac{1}{2}$	18	$1\frac{3}{4}$
$5\frac{1}{2}$	$2\frac{1}{2}$	15	$1\frac{7}{8}$	14	$1\frac{1}{4}$	$12\frac{1}{2}$	20	$1\frac{7}{8}$
6	$2\frac{3}{4}$	$16\frac{1}{2}$	2	15	$1\frac{3}{8}$	$13\frac{1}{2}$	22	2
$6\frac{1}{2}$	3	18	$2\frac{1}{8}$	16	$1\frac{1}{2}$	15	24	2
7	$3\frac{1}{4}$	19	$2\frac{1}{4}$	17	$1\frac{5}{8}$	16	$25\frac{1}{2}$	$2\frac{1}{4}$
$7\frac{1}{2}$	$3\frac{1}{2}$	$20\frac{1}{2}$	$2\frac{1}{2}$	$18\frac{1}{2}$	$1\frac{3}{4}$	17	$27\frac{1}{2}$	$2\frac{1}{4}$
8	$3\frac{3}{4}$	22	$2\frac{5}{8}$	20	$1\frac{7}{8}$	$18\frac{1}{2}$	$29\frac{1}{2}$	$2\frac{1}{2}$
$8\frac{1}{2}$	$3\frac{7}{8}$	23	$2\frac{3}{4}$	21	2	$19\frac{1}{2}$	$31\frac{1}{2}$	$2\frac{1}{2}$
9	4	24	$2\frac{7}{8}$	22	$2\frac{1}{8}$	$20\frac{1}{2}$	$33\frac{1}{2}$	$2\frac{3}{4}$
$9\frac{1}{2}$			3	$23\frac{1}{2}$	$2\frac{1}{8}$	$21\frac{1}{2}$	$34\frac{1}{2}$	$2\frac{3}{4}$
10			$3\frac{1}{4}$	$24\frac{1}{2}$	$2\frac{1}{4}$	$22\frac{1}{2}$	36	3
$10\frac{1}{2}$			$3\frac{3}{8}$	26	$2\frac{3}{8}$	24	38	3
11			$3\frac{5}{8}$	27	$2\frac{1}{2}$	25	40	3
$11\frac{1}{2}$			$3\frac{3}{4}$	$28\frac{1}{2}$	$2\frac{5}{8}$	26	42	3
12			$3\frac{7}{8}$	$29\frac{1}{2}$	$2\frac{3}{4}$	27	$43\frac{1}{2}$	$3\frac{1}{4}$
13			$4\frac{1}{4}$	32	3	$29\frac{1}{2}$	$47\frac{1}{2}$	$3\frac{1}{4}$
14			$4\frac{1}{2}$	$34\frac{1}{2}$	$3\frac{1}{8}$	32	51	$3\frac{1}{4}$
15			$4\frac{7}{8}$	37	$3\frac{3}{8}$	34	54	$3\frac{1}{4}$

MASTS of STEAM VESSELS. TABLE 47

LENGTH OF MAST FROM UPPER DECK TO HOUNDS.	DIAMETER AND THICKNESS OF MAST AT PARTNERS.	DIAMETER AND THICKNESS OF MAST AT HOUNDS.	LENGTH OF MAST FROM UPPER DECK TO HOUNDS.	DIAMETER AND THICKNESS OF MAST AT PARTNERS.	DIAMETER AND THICKNESS OF MAST AT HOUNDS.
Feet.	Inches.	Inches.	Feet.	Inches.	Inches.
30	16×·30	13½×·26	57	25×·38	20½×·34
33	17×·30	14 ×·26	60	26×·40	21 ×·36
36	18×·32	14½×·28	63	27×·42	22 ×·36
39	19×·32	15 ×·28	66	28×·44	23 ×·38
42	20×·34	16 ×·30	69	29×·46	24 ×·38
45	21×·34	17 ×·30	72	30×·48	25 ×·40
48	22×·36	18 ×·32	75	31×·50	26 ×·40
51	23×·36	19 ×·32	78	32×·50	27 ×·40
54	24×·38	20 ×·34	81	33×·50	28 ×·40

STAYS to MASTS of STEAMERS. TABLE 48

LENGTH OF MAST FROM UPPER DECK TO HOUNDS.	SHROUDS TO EACH SIDE OF MAST.		TOP MAST BACK STAY.		FORE TOP MAST STAY.		FORE STAY.
	Number.	Size.	Number.	Size.	Number.	Size.	
Feet.		Inches.		Inches.		Inches.	Inches.
30	2	2½	1	1½	—	—	2¾
33	2	2¾	1	1¾	—	—	3
36	2	3	1	2	—	—	3
39	3	3	1	2¼	1	2¼	3¼
42	3	3¼	1	2½	1	2½	3¼
45	3	3½	1	2¾	1	2¾	3½
48	3	3½	1	3	1	3	3½
51	3	3¾	1	3	1	3	3½
54	3	4	1	3	1	3	4
57	3	4	1	3	1	3	4
60	3	4¼	1	3	1	3	4
63	3	4½	1	3	1	3	4¼
66	3	4¾	1	3	1	3	4¼
69	3	5	2	3	2	3	4¼
72	3	5	2	3	2	3	4½
75	4	4½	2	3	2	3	4½
78	4	4¾	2	3	2	3	4½
81	4	5	2	3	2	3	4½

MASTS of SAILING VESSELS. TABLE 49

LENGTH OF MAST.		DIAMETER AND THICKNESS OF MAST.								SIZES OF ANGLE BARS IN MASTS.	CHEEKS.	
Fore and aft Rig.	Square Rig.	Partners.		Heel.		Hounds.		Head.			Thickness of Plate.	Sizes of Angle Bars.
Feet.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
36	30	16	·30	13	·26	13½	·26	11	·24		·40	3½ × 2½ × ·34
38	31	17	·30	13½	·26	14	·26	11½	·24		·40	3½ × 3 × ·36
41	33	18	·30	14	·26	15	·26	12	·26		·40	3½ × 3 × ·36
44	35	19	·34	15	·30	15½	·30	12½	·26		·44	4 × 3 × ·40
47	37	20	·34	16	·30	16½	·30	13½	·30		·44	4 × 3 × ·40
50	39	21	·34	16½	·30	17½	·30	14	·30		·44	4 × 3 × ·40
53	41	22	·36	17	·30	18½	·30	14½	·30		·46	4½ × 3 × ·40
56	43	23	·36	18	·30	19	·30	15½	·30		·46	4½ × 3 × ·44
60	45	24	·36	19	·30	20	·30	16	·30		·46	4½ × 3 × ·44
64	48	25	·40	19½	·34	21	·34	16½	·34		·50	5 × 3 × ·46
68	50	26	·40	20	·34	21½	·34	17½	·34		·50	5 × 3 × ·50
72	53	27	·44	21	·34	22½	·34	18	·34		·50	5 × 3½ × ·50
77	55	28	·44	22	·36	23	·36	18½	·36	3½ × 3 × ·40	·54	5 × 3½ × ·50
82	58	29	·46	22½	·36	24	·36	19½	·36	4 × 3 × ·40	·54	5½ × 4 × ·54
	60	30	·46	23	·40	25	·40	20	·36	4 × 3 × ·44	·56	6 × 4 × ·54
	63	31	·50	24	·40	26	·40	20½	·36	4½ × 3 × ·44	·60	6 × 4 × ·56
	65	32	·50	25	·40	26½	·40	21	·36	5 × 3 × ·46	·60	6 × 4 × ·56
	68	33	·50	26	·40	27	·40	21½	·36	5 × 3 × ·48	·60	6 × 4 × ·56

STEEL BOWSPRITS.

LENGTH OUTSIDE BED.	BED.		HEEL.		CAP.		SIZES OF ANGLE BARS.	LENGTH OUTSIDE BED.	BED.		HEEL.		CAP.		SIZES OF ANGLE BARS.
	Diameter.	Thickness.	Diameter	Thickness.	Diameter.	Thickness.			Diameter.	Thickness.	Diameter	Thickness.	Diameter.	Thickness.	
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14	16½	·30	14	·30	12	·30	2½ × 2 × ·30	21	25½	·40	21	·36	17½	·32	3½ × 3 × ·36
15	17½	·30	15	·30	12½	·30	2½ × 2 × ·30	22	26½	·40	22	·36	18½	·32	4 × 3 × ·40
16	19	·30	16	·30	13	·30	3 × 2 × ·30	23	28	·44	23	·40	19	·34	4 × 3½ × ·40
17	20	·34	17	·34	14	·30	3 × 2 × ·30	24	29	·44	24	·40	20	·34	4 × 3½ × ·40
18	21½	·36	18	·34	15	·30	3 × 2½ × ·30	25	30	·46	25	·40	21	·36	4½ × 3½ × ·42
19	23	·36	19	·34	16	·30	3 × 3 × ·32	26	31½	·46	26	·40	21½	·36	4½ × 3½ × ·44
20	24½	·40	20	·36	16½	·32	3½ × 3 × ·34	27	33	·46	27	·40	22	·36	4½ × 3½ × ·46

YARDS and TOPMASTS of SAILING VESSELS. TABLE 50

YARDS.											TOPMASTS.						
Length Cleated.	Centre.		First Quarter.		Second Quarter.		Third Quarter.		Ends at Cleats.		Length.	Heel.		Lower part of Head.		Head.	
	Dia.	Thickness.	Dia.	Thickness.	Dia.	Thickness.	Dia.	Thickness.	Dia.	Thickness.		Dia.	Thickness.	Dia.	Thickness.	Dia.	Thickness.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
32	8	·18	7⅞	·18	7¼	·18	6	·18	4	·12	12	12	·24	10½	·24	9	·18
36	9	·18	8¾	·18	8⅛	·18	6¾	·18	4½	·12	13½	12½	·24	11	·24	9½	·18
40	10	·20	9¾	·20	9	·18	7½	·18	5	·12	15	13	·24	11½	·24	10	·18
44	11	·22	10¾	·22	10	·18	8¼	·18	5½	·12	16½	14	·26	12½	·24	10½	·20
48	12	·24	11¾	·24	10¾	·20	9	·18	6	·14	18	14½	·26	13	·24	11	·22
52	13	·24	12⅝	·24	11¾	·22	9¾	·18	6½	·14	19½	15	·30	13½	·26	11½	·24
56	14	·26	13⅝	·26	12⅝	·24	10½	·20	7	·16	21	16	·30	14	·26	12	·24
60	15	·26	14⅝	·26	13½	·26	11¼	·22	7½	·16	22½	16½	·30	14½	·26	12½	·26
64	16	·30	15⅝	·30	14⅜	·30	12	·24	8	·18	24	17	·34	15	·30	13	·30
68	17	·30	16½	·30	15¼	·30	12¾	·24	8½	·18	25½	18	·34	16	·30	13½	·30
72	18	·30	17½	·30	16¼	·30	13½	·26	9	·18	27	18½	·34	16½	·30	14	·30
76	19	·32	18½	·30	17⅛	·30	14¼	·26	9½	·20	28½	19	·34	17	·30	14½	·30
80	20	·36	19½	·30	18	·30	15	·26	10	·22	30	20	·34	18	·30	15	·30
84	21	·40	20½	·34	19	·30	15¾	·30	10½	·24	31½	20½	·34	18½	·30	15½	·30
88	22	·40	21½	·34	19¾	·30	16½	·30	11	·24	33	21	·36	19	·30	16	·30
92	23	·40	22½	·36	20¾	·34	17¼	·30	11½	·26	35	22	·36	20	·30	16½	·30
96	24	·40	23⅜	·36	21⅝	·34	18	·30	12	·26	37	23	·36	21	·30	17	·30

STANDING RIGGING of SAILING VESSELS.

TABLE 51

(See Continuation.)

SECOND LONGITUDINAL NUMERAL L × (B + D).	6200		7100		8000		9000		10000		11400		12800		14200	
	No.	Size. Inches.	No.	Size Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.
FORE and MAIN Shrouds	4 of	$2\frac{1}{2}$	4 of	$2\frac{3}{4}$	5 of	3	5 of	$3\frac{1}{4}$ and cap	5 of	$3\frac{1}{2}$ and cap	5 of	$3\frac{3}{4}$ and cap	6 of	4 and cap	6 of	$4\frac{1}{8}$ and cap
„ „ Chain plates		$1\frac{1}{4}$		$1\frac{1}{4}$		$1\frac{3}{8}$		$1\frac{5}{8}$		$1\frac{3}{4}$		$1\frac{3}{4}$		$1\frac{7}{8}$		$1\frac{7}{8}$
„ „ Dead-eyes		$7\times4\frac{1}{2}$		$7\frac{1}{2}\times4\frac{1}{2}$		8×5		$8\frac{1}{2}\times5$		$9\times5\frac{1}{2}$		$9\frac{1}{2}\times5\frac{1}{2}$		10×6		$10\frac{1}{2}\times6$
„ „ Lanyards (hemp)		$3\frac{1}{2}$		$3\frac{3}{4}$		4		$4\frac{1}{4}$		$4\frac{1}{2}$		$4\frac{3}{4}$		5		$5\frac{1}{4}$
„ „ Rigging screws, diameter at bottom of thread		$1\frac{1}{8}$		$1\frac{1}{8}$		$1\frac{1}{4}$		$1\frac{3}{8}$		$1\frac{1}{2}$		$1\frac{1}{2}$		$1\frac{5}{8}$		$1\frac{5}{8}$
„ „ Rigging screws, diameter of pins		1		1		$1\frac{1}{8}$		$1\frac{1}{4}$		$1\frac{3}{8}$		$1\frac{3}{8}$		$1\frac{3}{8}$		$1\frac{3}{8}$
„ „ Topmast backstays	2 of	$2\frac{1}{2}$	2 of	$2\frac{3}{4}$	2 of	3	2 of	$3\frac{1}{4}$	2 of	$3\frac{1}{2}$	2 of	$3\frac{3}{4}$	3 of	4	3 of	$4\frac{1}{8}$
„ „ Top-gallant backstays		$1\frac{3}{4}$		2		$2\frac{1}{8}$		$2\frac{1}{4}$		$2\frac{3}{8}$	2 „	$2\frac{1}{2}$	2 „	$2\frac{5}{8}$	2 „	$2\frac{3}{4}$
„ „ Lower stays	2 of	$2\frac{1}{2}$	2 of	$2\frac{3}{4}$	2 of	3	2 of	$3\frac{1}{4}$	2 of	$3\frac{1}{2}$	2 „	$3\frac{3}{4}$	2 „	4	2 „	$4\frac{1}{8}$
„ „ Topmast stays		$2\frac{1}{2}$		$2\frac{3}{4}$		3		$3\frac{1}{4}$	2 „	$3\frac{1}{2}$	2 „	$3\frac{3}{4}$	2 „	4	2 „	$4\frac{1}{8}$
„ „ Top-gallant stays		$1\frac{3}{4}$		2		$2\frac{1}{8}$		$2\frac{1}{4}$		$2\frac{3}{8}$		$2\frac{1}{2}$		$2\frac{5}{8}$		$2\frac{3}{4}$
MIZZEN Shrouds	3 of	$2\frac{1}{4}$	3 of	$2\frac{3}{8}$	4 of	$2\frac{1}{2}$	4 of	$2\frac{5}{8}$	5 of	$2\frac{3}{4}$	5 of	$2\frac{7}{8}$	5 of	3	5 of	$3\frac{1}{4}$ and cap
„ Topmast backstays		$2\frac{1}{4}$		$2\frac{3}{8}$		$2\frac{1}{2}$	2 „	$2\frac{5}{8}$	2 „	$2\frac{3}{4}$	2 „	$2\frac{7}{8}$	3 „	3	3 „	$3\frac{1}{4}$
„ Top-gallant backstays		$1\frac{1}{4}$		$1\frac{3}{8}$		$1\frac{1}{2}$		$1\frac{5}{8}$		$1\frac{3}{4}$		$1\frac{7}{8}$	2 „	2	2 „	$2\frac{1}{8}$
„ Lower stays		$2\frac{1}{4}$		$2\frac{3}{8}$		$2\frac{1}{2}$		$2\frac{5}{8}$		$2\frac{3}{4}$		$2\frac{7}{8}$	2 „	3	2 „	$3\frac{1}{4}$
„ Topmast stays		$2\frac{1}{4}$		$2\frac{3}{8}$		$2\frac{1}{2}$		$2\frac{5}{8}$		$2\frac{3}{4}$		$2\frac{7}{8}$		3	2 „	$3\frac{1}{4}$
„ Top-gallant stays		$1\frac{1}{4}$		$1\frac{3}{8}$		$1\frac{1}{2}$		$1\frac{5}{8}$		$1\frac{3}{4}$		$1\frac{7}{8}$		2		$2\frac{1}{8}$
BOBSTAY Bar		2		2		2		2		$2\frac{1}{4}$		$2\frac{1}{2}$		3		$3\frac{1}{4}$
„ Pin		$1\frac{1}{2}$		$1\frac{1}{2}$		$1\frac{1}{2}$		$1\frac{1}{2}$		$1\frac{5}{8}$		$1\frac{7}{8}$		$2\frac{1}{8}$		$2\frac{1}{4}$
„ Chain		$1\frac{3}{16}$		$1\frac{4}{16}$		$1\frac{4}{16}$		$1\frac{4}{16}$		$1\frac{5}{16}$		$1\frac{6}{16}$		$1\frac{8}{16}$		$1\frac{10}{16}$
BOWSPRIT Shrouds (chain)		$\frac{9}{16}$		$\frac{9}{16}$		$\frac{10}{16}$		$\frac{11}{16}$		$\frac{12}{16}$	2 of	$\frac{12}{16}$	2 of	$\frac{13}{16}$	2 of	$\frac{14}{16}$

STANDING RIGGING of SAILING VESSELS.

TABLE 51
(Concluded.)

SECOND LONGITUDINAL NUMERAL L × (B + D).	15600		17000		18400		20000		21900		24200		27200	
	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.	No.	Size. Inches.
FORE and MAIN Shrouds	6 and cap	of $4\frac{1}{4}$	6 and cap	of $4\frac{1}{2}$	6 and cap	of $4\frac{3}{4}$	6 and cap	of $4\frac{7}{8}$	6 and cap	of 5	6 and cap	of $5\frac{1}{4}$	6 and cap	of $5\frac{1}{2}$
„ „ Chain plates...		2		$2\frac{1}{8}$		$2\frac{1}{4}$		$2\frac{3}{8}$		$2\frac{1}{2}$		$2\frac{5}{8}$		$2\frac{3}{4}$
„ „ Dead-eyes		11×6		$11\frac{1}{2} \times 6\frac{1}{2}$		12×7		—		—		—		—
„ „ Lanyards (hemp)		$5\frac{1}{2}$		$5\frac{3}{4}$		6		—		—		—		—
„ „ Rigging screws, diameter at bottom of thread		$1\frac{3}{4}$		$1\frac{3}{4}$		$1\frac{7}{8}$		$1\frac{7}{8}$		2		$2\frac{1}{8}$		$2\frac{1}{4}$
„ „ Rigging screws, diameter of pins		$1\frac{1}{2}$		$1\frac{1}{2}$		$1\frac{5}{8}$		$1\frac{5}{8}$		$1\frac{3}{4}$		$1\frac{7}{8}$		2
„ „ Topmast backstays	3	of $4\frac{1}{4}$	3	of $4\frac{1}{2}$	3	of $4\frac{3}{4}$	3	of $4\frac{7}{8}$	3	of 5	3	of $5\frac{1}{4}$	3	of $5\frac{1}{2}$
„ „ Top-gallant backstays	2 „	3	2 „	$3\frac{1}{4}$	2 „	$3\frac{1}{2}$	2 „	$3\frac{3}{4}$	2 „	$3\frac{7}{8}$	2 „	$4\frac{1}{8}$	2 „	$4\frac{1}{4}$
„ „ Lower stays...	2 „	$4\frac{1}{4}$	2 „	$4\frac{1}{2}$	2 „	$4\frac{3}{4}$	2 „	$4\frac{7}{8}$	2 „	5	2 „	$5\frac{1}{4}$	2 „	$5\frac{1}{2}$
„ „ Topmast stays	2 „	$4\frac{1}{4}$	2 „	$4\frac{1}{2}$	2 „	$4\frac{3}{4}$	2 „	$4\frac{7}{8}$	2 „	5	2 „	$5\frac{1}{4}$	2 „	$5\frac{1}{2}$
„ „ Top-gallant stays		3		$3\frac{1}{4}$		$3\frac{1}{2}$		$3\frac{3}{4}$		$3\frac{7}{8}$		$4\frac{1}{8}$		$4\frac{1}{4}$
MIZZEN Shrouds	5 and cap	of $3\frac{1}{2}$	5 and cap	of $3\frac{3}{4}$	5 and cap	of 4	5 and cap	of $4\frac{1}{8}$	5 and cap	of $4\frac{1}{4}$	5 and cap	of $4\frac{3}{8}$	5 and cap	of $4\frac{1}{2}$
„ Topmast backstays	3 „	$3\frac{1}{2}$	3 „	$3\frac{3}{4}$	3 „	4	3 „	$4\frac{1}{8}$	3 „	$4\frac{1}{4}$	3 „	$4\frac{3}{8}$	3 „	$4\frac{1}{2}$
„ Top-gallant backstays	2 „	$2\frac{1}{4}$	2 „	$2\frac{1}{2}$	2 „	$2\frac{3}{4}$	2 „	$2\frac{7}{8}$	2 „	3	2 „	$3\frac{1}{8}$	2 „	$3\frac{1}{4}$
„ Lower stays	2 „	$3\frac{1}{2}$	2 „	$3\frac{3}{4}$	2 „	4	2 „	$4\frac{1}{8}$	2 „	$4\frac{1}{4}$	2 „	$4\frac{3}{8}$	2 „	$4\frac{1}{2}$
„ Topmast stays	2 „	$3\frac{1}{2}$	2 „	$3\frac{3}{4}$	2 „	4	2 „	$4\frac{1}{8}$	2 „	$4\frac{1}{4}$	2 „	$4\frac{3}{8}$	2 „	$4\frac{1}{2}$
„ Top-gallant stays		$2\frac{1}{4}$		$2\frac{1}{2}$		$2\frac{3}{4}$		$2\frac{7}{8}$		3		$3\frac{1}{8}$		$3\frac{1}{4}$
BOBSTAY Bar		$3\frac{1}{2}$		$3\frac{3}{4}$		$3\frac{3}{4}$		$3\frac{7}{8}$		4		$4\frac{1}{8}$		$4\frac{1}{8}$
„ Pin		$2\frac{1}{2}$		$2\frac{5}{8}$		$2\frac{3}{4}$		$2\frac{7}{8}$		3		$3\frac{1}{8}$		$3\frac{1}{8}$
„ Chain		$1\frac{19}{16}$		$1\frac{13}{16}$		$1\frac{14}{16}$		$1\frac{15}{16}$		2		$2\frac{1}{16}$		$2\frac{1}{16}$
BOWSPRIT Shrouds (chain)	2	of $\frac{14}{16}$	2	of 1	2	of 1	2	of $1\frac{1}{16}$	2	of $1\frac{1}{16}$	2	of $1\frac{2}{16}$	2	of $1\frac{2}{16}$

ANCHOR CRANES. TABLE 52

WEIGHT OF ANCHOR INCLUDING STOCK.	OUTREACH OF CRANE.							
	Feet. 9	Feet. 10	Feet. 11	Feet. 12	Feet. 13	Feet. 14	Feet. 15	Feet. 16
	DIAMETER OF MAIN POST AT DECK.							
Cwts. 20	Inches. 6	Inches. 6¼	Inches. 6½	Inches. 6¾	Inches. 6¾	Inches. 7	Inches. 7¼	Inches. 7½
25	6½	6¾	7	7¼	7¼	7½	7¾	8
30	7	7¼	7½	7¾	7¾	8	8¼	8½
35	7¼	7½	7¾	8	8	8¼	8½	8¾
40	7½	7¾	8	8¼	8½	8¾	9	9¼
45	8	8¼	8½	8¾	9	9¼	9½	9¾
50	8¼	8½	8¾	9	9¼	9½	9¾	10
55	8½	8¾	9	9¼	9½	9¾	10	10¼
60	8¾	9	9¼	9½	9¾	10	10¼	10½

CORRESPONDING DIMENSIONS OF MAIN POST, TIE RODS AND JIBS.

	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Diameter of Main Post at Deck ...	6	6½	7	7½	8	8½	9	9½	10	10½	11
Tie Rod	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	2⅞	3
Jib (Diameter at Middle)	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½

Where two tie rods are fitted the diameter of each is to be three-quarters that of the single rod required.

TABLE OF EQUIVALENT SIZES.

DIAMETER IN INCHES AT DECK OF SOLID WROUGHT IRON DAVITS OR OF MAIN POSTS OF ANCHOR CRANES.	Ins. 3	Ins. 3¼	Ins. 3½	Ins. 3¾	Ins. 4	Ins. 4¼	Ins. 4½	Ins. 4¾	Ins. 5	Ins. 5¼	Ins. 5½	Ins. 5¾	Ins. 6	Ins. 6¼	Ins. 6½	Ins. 6¾	Ins. 7	Ins. 7¼	Ins. 7½	Ins. 7¾	Ins. 8	Ins. 8¼	Ins. 8½
DIAMETER AND THICKNESS IN INCHES OF APPROVED WELDLESS DRAWN STEEL HOLLOW BOAT OR ANCHOR DAVITS.	4 × 4/16	4½ × 4/16	4¾ × 4/16	5¼ × 4/16	5¼ × 5/16	5¾ × 5/16	6 × 5/16	6½ × 5/16	6½ × 6/16	7 × 6/16	7¼ × 6/16	7¾ × 6/16	7¾ × 7/16	8¼ × 7/16	8½ × 7/16	9 × 7/16	9 × 8/16	9½ × 8/16	9¾ × 8/16	10¼ × 8/16	10¼ × 9/16	10¾ × 9/16	11 × 9/16

ANCHORS and CHAINS for STEAM VESSELS.

TABLE 53

(See Continuation.)

* EQUIPMENT NUMBER.	Letters for Equipment as inserted in Register Book, Column 7.	ANCHORS. Number. Bowers.	Number. Stream.	Bower Anchors. Ex Stock. Weight.	Ex Stock. Test.	Ex Stock. Collective Weight.	Stockless. Weight.	Stockless. Test.	Stockless. Collective Weight.	Stream Anchors. Ex Stock. Stream.	Ex Stock. Test.	CHAIN CABLES. Wrought Iron Stud Chain Cables. Length.	Minimum Size.	Proved to Statutory Test.	Breaking Test.	Minimum Weight.
				Cwts.	Tons.	Cwts.	Cwts.	Tons.	Cwts.	Cwts.	Tons.	Fms.	Inches.	Tons.	Tons.	Cwts.
3000	*a*	2	1	$3\frac{1}{2}$	$5\frac{18}{20}$	7	$4\frac{1}{2}$	$6\frac{17}{20}$	$8\frac{3}{4}$	$\frac{3}{4}$	—	120	$\frac{11}{16}$	$8\frac{5}{10}$	$12\frac{3}{4}$	29
3600	*b*	2	1	$4\frac{1}{4}$	$6\frac{12}{20}$	$8\frac{1}{2}$	$5\frac{1}{4}$	$7\frac{11}{20}$	$10\frac{1}{2}$	$1\frac{1}{4}$	$3\frac{13}{20}$	120	$\frac{12}{16}$	$10\frac{1}{8}$	$15\frac{1}{8}$	$34\frac{1}{2}$
4200	*c*	2	1	5	$7\frac{7}{20}$	10	$6\frac{1}{4}$	$8\frac{10}{20}$	$12\frac{1}{2}$	$1\frac{3}{4}$	$4\frac{4}{20}$	135	$\frac{13}{16}$	$11\frac{7}{8}$	$17\frac{8}{10}$	46
4800	*d*	2	1	$5\frac{3}{4}$	8	$11\frac{1}{2}$	$7\frac{1}{4}$	$9\frac{9}{20}$	$14\frac{1}{4}$	$2\frac{1}{4}$	$4\frac{15}{20}$	165	$\frac{14}{16}$	$13\frac{3}{4}$	$20\frac{5}{8}$	$64\frac{1}{4}$
5400	*e*	2	1	$6\frac{1}{2}$	$8\frac{15}{20}$	13	$8\frac{1}{4}$	$10\frac{7}{20}$	$16\frac{1}{4}$	$2\frac{3}{4}$	$5\frac{5}{20}$	165	$\frac{15}{16}$	$15\frac{8}{10}$	$23\frac{7}{10}$	$74\frac{1}{2}$
6000	*f*	2	1	$7\frac{1}{4}$	$9\frac{9}{20}$	$14\frac{1}{2}$	9	$11\frac{2}{20}$	18	3	$5\frac{10}{20}$	165	1	18	27	84
6700	*g*	3	1	$8\frac{1}{4}$	$10\frac{7}{20}$	$23\frac{1}{2}$	$10\frac{1}{4}$	$12\frac{4}{20}$	$29\frac{1}{4}$	$3\frac{1}{2}$	$5\frac{18}{20}$	165	$1\frac{1}{16}$	$20\frac{3}{10}$	$30\frac{4}{10}$	$95\frac{1}{4}$
7400	*h*	3	1	10	12	$28\frac{1}{2}$	$12\frac{1}{2}$	$14\frac{6}{20}$	$35\frac{1}{2}$	4	$6\frac{7}{20}$	195	$1\frac{2}{16}$	$22\frac{3}{4}$	$34\frac{1}{8}$	$126\frac{1}{4}$
8100	*i*	3	1	$11\frac{3}{4}$	$13\frac{12}{20}$	$33\frac{1}{2}$	$14\frac{1}{2}$	$16\frac{1}{20}$	$41\frac{3}{4}$	$4\frac{1}{4}$	$6\frac{12}{20}$	195	$1\frac{3}{16}$	$25\frac{3}{8}$	38	$141\frac{1}{4}$
8900	*j*	3	1	$13\frac{1}{2}$	$15\frac{3}{20}$	$38\frac{1}{2}$	$16\frac{3}{4}$	18	48	$4\frac{3}{4}$	$7\frac{2}{20}$	210	$1\frac{4}{16}$	$28\frac{1}{8}$	$42\frac{1}{8}$	168
9700	*k*	3	1	$15\frac{1}{4}$	$16\frac{14}{20}$	$43\frac{1}{2}$	19	$19\frac{17}{20}$	$54\frac{1}{4}$	$5\frac{1}{4}$	$7\frac{11}{20}$	210	$1\frac{5}{16}$	31	$46\frac{1}{2}$	$185\frac{1}{2}$
10600	*l*	3	1	17	$18\frac{5}{20}$	$48\frac{1}{2}$	$21\frac{1}{4}$	$21\frac{16}{20}$	$60\frac{1}{2}$	$5\frac{3}{4}$	8	210	$1\frac{6}{16}$	34	51	203
11600	*m*	3	1	$18\frac{3}{4}$	$19\frac{13}{20}$	$53\frac{1}{2}$	$23\frac{1}{4}$	$23\frac{6}{20}$	$66\frac{3}{4}$	6	$8\frac{5}{20}$	210	$1\frac{7}{16}$	$37\frac{1}{8}$	$55\frac{5}{8}$	$222\frac{1}{2}$
12700	*n*	3	1	$20\frac{1}{2}$	$21\frac{3}{20}$	$58\frac{1}{2}$	$25\frac{1}{2}$	$25\frac{3}{20}$	73	$6\frac{1}{2}$	$8\frac{15}{20}$	210	$1\frac{8}{16}$	$40\frac{5}{10}$	$58\frac{7}{10}$	242
13900	*o*	3	1	$22\frac{1}{2}$	$22\frac{15}{20}$	64	28	$27\frac{2}{20}$	80	7	$9\frac{5}{20}$	240	$1\frac{9}{16}$	$43\frac{9}{10}$	$61\frac{4}{10}$	$298\frac{3}{4}$
15200	*p*	3	1	$24\frac{1}{2}$	$24\frac{6}{20}$	$69\frac{1}{2}$	$30\frac{1}{2}$	29	87	$7\frac{3}{4}$	$9\frac{18}{20}$	240	$1\frac{10}{16}$	$47\frac{5}{10}$	$66\frac{5}{10}$	$319\frac{1}{2}$
16700	*q*	3	1	$26\frac{1}{2}$	26	75	33	$30\frac{17}{20}$	94	$8\frac{1}{2}$	$10\frac{12}{20}$	240	$1\frac{11}{16}$	$51\frac{1}{4}$	$71\frac{3}{4}$	$344\frac{3}{4}$
18500	*r*	3	1	$28\frac{1}{2}$	$27\frac{10}{20}$	81	$35\frac{1}{2}$	$32\frac{15}{20}$	101	$9\frac{1}{4}$	$11\frac{6}{20}$	240	$1\frac{12}{16}$	$55\frac{1}{8}$	$77\frac{1}{8}$	$370\frac{1}{2}$
20600	*s*	3	1	31	$29\frac{7}{20}$	88	$38\frac{3}{4}$	$34\frac{19}{20}$	110	10	12	240	$1\frac{13}{16}$	$59\frac{1}{8}$	$82\frac{3}{4}$	$397\frac{3}{4}$
22700	*t*	3	1	$33\frac{1}{2}$	$31\frac{5}{20}$	$95\frac{1}{2}$	42	$37\frac{2}{20}$	$119\frac{1}{2}$	11	$12\frac{17}{20}$	240	$1\frac{14}{16}$	$63\frac{1}{4}$	$88\frac{5}{10}$	$425\frac{1}{4}$
25000	*u*	3	1	36	$33\frac{2}{20}$	103	45	$39\frac{5}{20}$	128	12	$13\frac{17}{20}$	270	$1\frac{15}{16}$	$67\frac{5}{10}$	$94\frac{5}{10}$	$511\frac{1}{2}$
27300	*v*	3	1	39	$35\frac{2}{20}$	111	$48\frac{3}{4}$	$41\frac{1}{20}$	139	13	$14\frac{15}{20}$	270	2	72	$100\frac{8}{10}$	$538\frac{3}{4}$
29700	*w*	3	1	42	$37\frac{2}{20}$	$119\frac{1}{2}$	$52\frac{1}{2}$	$43\frac{18}{20}$	$149\frac{1}{2}$	14	$15\frac{12}{20}$	270	$2\frac{1}{16}$	$76\frac{5}{10}$	$107\frac{1}{10}$	$573\frac{3}{4}$
32200	*x*	3	1	45	$39\frac{5}{20}$	128	$56\frac{1}{4}$	$46\frac{3}{20}$	160	15	$16\frac{10}{20}$	270	$2\frac{2}{16}$	$81\frac{1}{4}$	$113\frac{3}{4}$	$608\frac{3}{4}$
34800	*y*	3	1	48	$41\frac{2}{20}$	$136\frac{1}{2}$	60	$48\frac{7}{20}$	$170\frac{1}{2}$	$16\frac{1}{4}$	$17\frac{11}{20}$	270	$2\frac{3}{16}$	$86\frac{1}{8}$	$120\frac{5}{10}$	$645\frac{3}{4}$
37600	*z*	3	1	51	43	$145\frac{1}{2}$	$63\frac{3}{4}$	$50\frac{7}{20}$	182	$17\frac{1}{2}$	$18\frac{12}{20}$	270	$2\frac{4}{16}$	$91\frac{1}{8}$	$127\frac{5}{10}$	$682\frac{1}{4}$
40400	*a*†	3	1	$54\frac{1}{2}$	$45\frac{1}{20}$	$155\frac{1}{2}$	68	$52\frac{12}{20}$	$194\frac{1}{2}$	19	$19\frac{17}{20}$	270	$2\frac{5}{16}$	$96\frac{1}{4}$	$134\frac{3}{4}$	$720\frac{3}{4}$
43200	*b*†	3	1	58	$47\frac{5}{20}$	$165\frac{1}{2}$	$72\frac{1}{2}$	55	207	$20\frac{1}{2}$	$21\frac{3}{20}$	300	$2\frac{6}{16}$	$101\frac{5}{10}$	$142\frac{1}{10}$	$844\frac{1}{4}$
46000	*c*†	3	1	$61\frac{1}{2}$	$49\frac{3}{20}$	$175\frac{1}{2}$	77	$57\frac{5}{20}$	$219\frac{1}{2}$	22	$22\frac{7}{20}$	300	$2\frac{7}{16}$	$106\frac{9}{10}$	$149\frac{5}{8}$	$890\frac{1}{4}$
48800	*d*†	3	1	65	51	$185\frac{1}{2}$	$81\frac{1}{4}$	$59\frac{2}{20}$	232	$23\frac{1}{2}$	$23\frac{10}{20}$	300	$2\frac{8}{16}$	$112\frac{5}{10}$	$157\frac{5}{10}$	940
51600	*e*†	3	1	$68\frac{1}{2}$	$52\frac{18}{20}$	$195\frac{1}{2}$	$85\frac{1}{2}$	$61\frac{5}{20}$	$244\frac{1}{2}$	25	$24\frac{15}{20}$	300	$2\frac{9}{16}$	$116\frac{7}{10}$	$163\frac{3}{8}$	989
54600	*f*†	3	1	72	$54\frac{15}{20}$	206	90	$63\frac{5}{20}$	$257\frac{1}{2}$	$26\frac{1}{2}$	26	300	$2\frac{10}{16}$	$120\frac{9}{10}$	$169\frac{1}{4}$	1040
57600	*g*†	3	1	76	$56\frac{15}{20}$	217	95	$65\frac{7}{20}$	271	28	$27\frac{2}{20}$	330	$2\frac{11}{16}$	$125\frac{1}{10}$	$175\frac{1}{8}$	1200
60600	*h*†	3	1	80	$58\frac{10}{20}$	228	100	$67\frac{5}{20}$	285	$29\frac{1}{2}$	$28\frac{5}{20}$	330	$2\frac{12}{16}$	$129\frac{3}{10}$	181	1258
63800	*i*†	3	1	$83\frac{1}{2}$	$60\frac{5}{20}$	238	$104\frac{1}{2}$	$68\frac{19}{20}$	298	31	$29\frac{7}{20}$	330	$2\frac{13}{16}$	$133\frac{4}{10}$	$186\frac{3}{4}$	1317
67000	*j*†	3	1	87	$61\frac{17}{20}$	248	109	$70\frac{12}{20}$	311	$32\frac{1}{2}$	$30\frac{10}{20}$	330	$2\frac{14}{16}$	$137\frac{6}{10}$	$192\frac{5}{8}$	1378
70200	*k*†	3	1	91	$63\frac{12}{20}$	259	$113\frac{1}{2}$	$72\frac{6}{20}$	324	34	$31\frac{12}{20}$	330	$2\frac{15}{16}$	$141\frac{7}{10}$	$198\frac{3}{8}$	1440
73400	*l*†	3	1	$94\frac{1}{2}$	$65\frac{3}{20}$	269	118	74	336	$35\frac{1}{2}$	$32\frac{15}{20}$	330	3	$145\frac{8}{10}$	$204\frac{1}{10}$	1503
76800	*m*†	3	1	98	$66\frac{10}{20}$	279	$122\frac{1}{2}$	$75\frac{10}{20}$	349	$37\frac{1}{4}$	$33\frac{18}{20}$	330	$3\frac{1}{16}$	$149\frac{8}{10}$	$209\frac{7}{10}$	1568
80200	*n*†	3	1	$101\frac{1}{2}$	$67\frac{16}{20}$	290	127	$76\frac{18}{20}$	362	39	$35\frac{2}{20}$	330	$3\frac{2}{16}$	$153\frac{3}{4}$	$215\frac{1}{4}$	1634
83800	*o*†	3	1	$105\frac{1}{2}$	$69\frac{6}{20}$	301	132	$78\frac{10}{20}$	376	$40\frac{3}{4}$	$36\frac{6}{20}$	330	$3\frac{3}{16}$	$157\frac{7}{10}$	$220\frac{3}{4}$	1701
87600	*p*†	3	1	$109\frac{1}{2}$	$70\frac{16}{20}$	312	137	$80\frac{1}{20}$	390	$42\frac{1}{2}$	$37\frac{10}{20}$	330	$3\frac{4}{16}$	$161\frac{6}{10}$	$226\frac{2}{10}$	1769
91600	*q*†	3	1	$113\frac{1}{2}$	$72\frac{6}{20}$	324	142	$81\frac{12}{20}$	404	$44\frac{1}{4}$	$38\frac{15}{20}$	330	$3\frac{5}{16}$	$165\frac{4}{10}$	$231\frac{5}{10}$	1839
95800	*r*†	3	1	118	74	336	$147\frac{1}{2}$	$83\frac{6}{20}$	420	46	$39\frac{17}{20}$	330	$3\frac{6}{16}$	$169\frac{1}{8}$	$236\frac{3}{4}$	1910
100200	*s*†	3	1	$122\frac{1}{2}$	$75\frac{10}{20}$	349	153	85	436	$47\frac{3}{4}$	$40\frac{19}{20}$	330	$3\frac{7}{16}$	$172\frac{3}{4}$	$241\frac{8}{10}$	1983
105000	*t*†	3	1	127	$76\frac{18}{20}$	362	159	$86\frac{10}{20}$	452	$49\frac{1}{2}$	$42\frac{1}{20}$	330	$3\frac{8}{16}$	$176\frac{4}{10}$	$246\frac{9}{10}$	2057

* Where the equipment number lies between any two consecutive numbers given in the Table the equipment is to be governed by the greater.

ANCHORS and CHAINS for STEAM VESSELS.

TABLE 53
(Concluded.)

* EQUIPMENT NUMBER.	Letters for Equipment as inserted in Register Book, Column 7	STREAM CHAIN OR STEEL WIRE.						TOWLINE, HEMP OR STEEL WIRE.				HAWSERS AND WARPS. HEMP OR STEEL WIRE.						
			Chain.			Steel Wire.			Hemp.	Steel Wire.			Hawsers.			Warps.		
		Length.	Size.	Minimum Weight.		Size.	Breaking Test.	Length.	Size.	Size.	Breaking Test.	Length of Each.	Number.	Hemp.	Flexible Steel Wire Rope.	Number.	Hemp.	Flexible Steel Wire Rope.
				Stud Link.	Short Link.									Size.	Size. (*b*)		Size.	Size. (*b*)
		Fathoms.	Inches.	Cwt.	Cwt.	Inches.	Tons.	Fathoms.	Inches.	Inches.	Tons.	Fathoms.		Inches.	Inches.		Inches.	Inches.
3000	*a*	45	$\frac{8}{16}$	$6\frac{1}{2}$	$7\frac{1}{4}$	—	—	75	$5\frac{1}{2}$	2	8·3	90	1	3	—	—	—	—
3600	*b*	45	$\frac{9}{16}$	8	$8\frac{3}{4}$	2	8·3	75	6	$2\frac{1}{4}$	10·8	90	1	4	—	—	—	—
4200	*c*	45	$\frac{9}{16}$	8	$8\frac{3}{4}$	2	8·3	75	6	$2\frac{1}{4}$	10·8	90	1	4	—	—	—	—
4800	*d*	45	$\frac{10}{16}$	$9\frac{3}{4}$	$10\frac{1}{2}$	$2\frac{1}{4}$	10·8	75	$6\frac{1}{2}$	$2\frac{1}{4}$	10·8	90	1	4	—	—	—	—
5400	*e*	45	$\frac{10}{16}$	$9\frac{3}{4}$	$10\frac{1}{2}$	$2\frac{1}{4}$	10·8	75	7	$2\frac{1}{2}$	13·2	90	1	5	$1\frac{3}{4}$	—	—	—
6000	*f*	45	$\frac{11}{16}$	11	12	$2\frac{1}{2}$	13·2	75	$7\frac{1}{2}$	$2\frac{1}{2}$	13·2	90	1	$5\frac{1}{2}$	2	—	—	—
6700	*g*	60	$\frac{11}{16}$	$14\frac{1}{2}$	$15\frac{3}{4}$	$2\frac{1}{2}$	13·2	75	$7\frac{1}{2}$	$2\frac{1}{2}$	13·2	90	1	$5\frac{1}{2}$	2	—	—	—
7400	*h*	60	$\frac{12}{16}$	$17\frac{1}{4}$	$18\frac{3}{4}$	$2\frac{3}{4}$	15·2	75	8	$2\frac{3}{4}$	15·2	90	1	6	$2\frac{1}{4}$	—	—	—
8100	*i*	60	$\frac{13}{16}$	$20\frac{1}{2}$	22	3	18·6	75	$8\frac{1}{2}$	$2\frac{3}{4}$	15·2	90	1	6	$2\frac{1}{4}$	—	—	—
8900	*j*	60	$\frac{13}{16}$	$20\frac{1}{2}$	22	3	18·6	75	$8\frac{1}{2}$	$2\frac{3}{4}$	15·2	90	1	6	$2\frac{1}{4}$	1	4	—
9700	*k*	60	$\frac{14}{16}$	$23\frac{1}{2}$	$25\frac{1}{2}$	$3\frac{1}{4}$	21·7	90	9	3	18·6	90	1	6	$2\frac{1}{4}$	1	5	$1\frac{3}{4}$
10600	*l*	60	$\frac{14}{16}$	$23\frac{1}{2}$	$25\frac{1}{2}$	$3\frac{1}{4}$	21·7	90	9	3	18·6	90	1	6	$2\frac{1}{4}$	1	5	$1\frac{3}{4}$
11600	*m*	60	$\frac{15}{16}$	27	29	$3\frac{1}{2}$	25·7	90	—	$3\frac{1}{4}$	21·7	90	1	6	$2\frac{1}{4}$	1	5	$1\frac{3}{4}$
12700	*n*	75	$\frac{15}{16}$	34	$35\frac{1}{2}$	$3\frac{1}{2}$	25·7	90	—	$3\frac{1}{4}$	21·7	90	1	6	$2\frac{1}{4}$	1	5	$1\frac{3}{4}$
13900	*o*	75	1	$38\frac{1}{4}$	$41\frac{1}{4}$	$3\frac{3}{4}$	29·3	90	—	$3\frac{1}{4}$	21·7	90	1	6	$2\frac{1}{4}$	1	5	$1\frac{3}{4}$
15200	*p*	75	1	$38\frac{1}{4}$	$41\frac{1}{4}$	$3\frac{3}{4}$	29·3	90	—	$3\frac{1}{4}$	21·7	90	2	6	$2\frac{1}{4}$	2	5	$1\frac{3}{4}$
16700	*q*	75	$1\frac{1}{16}$	$43\frac{1}{4}$	$46\frac{1}{4}$	4	33·2	90	—	$3\frac{1}{2}$	25·7	90	2	6	$2\frac{1}{4}$	2	5	$1\frac{3}{4}$
18500	*r*	75	$1\frac{1}{16}$	$43\frac{1}{4}$	$46\frac{1}{4}$	4	33·2	90	—	$3\frac{1}{2}$	25·7	90	2	6	$2\frac{1}{4}$	2	5	$1\frac{3}{4}$
20600	*s*	75	$1\frac{2}{16}$	$48\frac{1}{2}$	52	$4\frac{1}{4}$	36·4	90	—	4	33·2	90	2	7	$2\frac{1}{2}$	2	6	$2\frac{1}{4}$
22700	*t*	75	$1\frac{2}{16}$	$48\frac{1}{2}$	52	$4\frac{1}{4}$	36·4	100	—	4	33·2	90	2	7	$2\frac{1}{2}$	2	6	$2\frac{1}{4}$
25000	*u*	90	$1\frac{2}{16}$	$51\frac{1}{4}$	$62\frac{1}{4}$	$4\frac{1}{4}$	36·4	100	—	4	33·2	90	2	7	$2\frac{1}{2}$	2	6	$2\frac{1}{4}$
27300	*v*	90	$1\frac{3}{16}$	$65\frac{1}{4}$	$69\frac{3}{4}$	$4\frac{1}{2}$	43·3	120	—	4	33·2	90	2	7	$2\frac{1}{2}$	2	7	$2\frac{1}{2}$
29700	*w*	90	$1\frac{3}{16}$	$65\frac{1}{4}$	$69\frac{3}{4}$	$4\frac{1}{2}$	43·3	120	—	$4\frac{1}{2}$	43·3	90	2	7	$2\frac{1}{2}$	2	7	$2\frac{1}{2}$
32200	*x*	90	$1\frac{3}{16}$	$65\frac{1}{4}$	$69\frac{3}{4}$	$4\frac{1}{2}$	43·3	120	—	$4\frac{1}{2}$	43·3	90	2	7	$2\frac{1}{2}$	2	7	$2\frac{1}{2}$
34800	*y*	90	$1\frac{4}{16}$	72	77	$4\frac{3}{4}$	47·0	120	—	$4\frac{3}{4}$	47·0	90	2	8	$2\frac{3}{4}$	2	7	$2\frac{1}{2}$
37600	*z*	90	$1\frac{4}{16}$	72	77	$4\frac{3}{4}$	47·0	120	—	5	52·8	90	2	8	$2\frac{3}{4}$	2	7	$2\frac{1}{2}$
40400	*a*†	90	$1\frac{5}{16}$	$79\frac{1}{2}$	85	5	52·8	120	—	$4\frac{3}{4}$	64·6	90	2	8	$2\frac{3}{4}$	2	7	$2\frac{1}{2}$
43200	*b*†	120	$1\frac{5}{16}$	106	$113\frac{1}{4}$	5	52·8	130	—	5	70·9	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
46000	*c*†	120	$1\frac{5}{16}$	106	$113\frac{1}{4}$	5	52·8	130	—	$5\frac{1}{4}$	77·5	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
48800	*d*†	120	$1\frac{6}{16}$	116	124	$4\frac{3}{4}$	64·6	130	—	$5\frac{1}{2}$	84·4	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
51600	*e*†	120	$1\frac{6}{16}$	116	124	$4\frac{3}{4}$	64·6	130	—	$5\frac{1}{2}$	84·4	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
54600	*f*†	120	$1\frac{7}{16}$	$126\frac{3}{4}$	$135\frac{1}{2}$	5	70·9	130	—	$5\frac{1}{2}$	84·4	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
57600	*g*†	120	$1\frac{8}{16}$	$138\frac{1}{4}$	$146\frac{1}{2}$	$5\frac{1}{2}$	84·4	130	—	$6\frac{1}{2}$	112·3	100	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
60600	*h*†	120	$1\frac{8}{16}$	$138\frac{1}{4}$	$146\frac{1}{2}$	$5\frac{1}{2}$	84·4	130	—	$6\frac{1}{2}$	112·3	120	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
63800	*i*†	120	$1\frac{9}{16}$	$149\frac{1}{4}$	159	$5\frac{1}{2}$	84·4	130	—	$6\frac{1}{2}$	112·3	120	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
67000	*j*†	120	$1\frac{10}{16}$	$159\frac{3}{4}$	$171\frac{1}{2}$	$5\frac{1}{2}$	84·4	130	—	$6\frac{1}{2}$	112·3	120	2	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
70200	*k*†	150	$1\frac{11}{16}$	$215\frac{1}{2}$	$231\frac{1}{2}$	6	99·1	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
73400	*l*†	150	$1\frac{12}{16}$	$231\frac{1}{2}$	$249\frac{1}{2}$	6	99·1	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
76800	*m*†	150	$1\frac{13}{16}$	$248\frac{1}{2}$	$268\frac{1}{2}$	6	99·1	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	2	8	$2\frac{3}{4}$
80200	*n*†	150	$1\frac{13}{16}$	$248\frac{1}{2}$	$268\frac{1}{2}$	6	99·1	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
83800	*o*†	150	$1\frac{14}{16}$	$265\frac{3}{4}$	288	$6\frac{1}{2}$	112·3	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
87600	*p*†	150	$1\frac{14}{16}$	$265\frac{3}{4}$	288	$6\frac{1}{2}$	112·3	140	—	7	130·7	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
91600	*q*†	150	$1\frac{15}{16}$	284	309	$6\frac{1}{2}$	112·3	150	—	8	148·8	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
95800	*r*†	150	$1\frac{15}{16}$	284	309	$6\frac{1}{2}$	112·3	150	—	8	148·8	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
100200	*s*†	150	2	$299\frac{1}{4}$	330	7	130·7	150	—	8	148·8	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$
105000	*t*†	150	2	$299\frac{1}{4}$	330	7	130·7	150	—	8	148·8	120	3	8	$2\frac{3}{4}$	3	8	$2\frac{3}{4}$

* Where the equipment number lies between any two consecutive numbers given in the Table the equipment is to be governed by the greater.

(*b*) 6 × 12 Flexible Steel Wire Ropes. (*c*) 6 × 24 Special Flexible Steel Wire Ropes. (*d*) 6 × 30 Special Flexible Steel Wire Ropes.

ANCHORS and CHAINS for SAILING VESSELS.

TABLE 54

(See Continuation.)

* EQUIPMENT NUMBER.	Letters for Equipment as inserted in Register Book, Column 8	ANCHORS.									CHAIN CABLES.				
		Number.			Bower Anchors. Ex Stock.			Stream and Kedge Anchors. Ex Stock.			Wrought Iron Stud Chain Cables.				
		Bowers.	Stream.	Kedge.	Weight.	Test.	Collective Weight.	Stream.	Test.	Kedge.	Test.	Length.	Minimum Size.	Proved to Statutory Test.	Breaking Test.	Minimum Weight.
					Cwts.	Tons.	Cwts.	Cwts.	Tons.	Cwts.	Tons.	Fms.	Inches.	Tons.	Tons.	Cwts.
2100	*a*	2	1	1	$3\frac{1}{2}$	$5\frac{18}{20}$	7	$\frac{3}{4}$	—	$\frac{1}{2}$	—	120	$\frac{11}{16}$	$8\frac{5}{10}$	$12\frac{3}{4}$	29
2500	*b*	2	1	1	$4\frac{1}{4}$	$6\frac{12}{20}$	$8\frac{1}{2}$	$1\frac{1}{4}$	$3\frac{13}{20}$	$\frac{1}{2}$	—	120	$\frac{12}{16}$	$10\frac{1}{8}$	$15\frac{1}{8}$	$34\frac{1}{2}$
3000	*c*	2	1	1	5	$7\frac{7}{20}$	10	$1\frac{1}{2}$	$3\frac{18}{20}$	$\frac{3}{4}$	—	135	$\frac{13}{16}$	$11\frac{7}{8}$	$17\frac{8}{10}$	46
3400	*d*	2	1	1	$5\frac{3}{4}$	8	$11\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{18}{20}$	$\frac{3}{4}$	—	165	$\frac{14}{16}$	$13\frac{3}{4}$	$20\frac{5}{8}$	$64\frac{1}{4}$
3900	*e*	2	1	1	$6\frac{1}{2}$	$8\frac{15}{20}$	13	2	$4\frac{10}{20}$	1	—	165	$\frac{15}{16}$	$15\frac{8}{10}$	$23\frac{7}{10}$	$74\frac{1}{2}$
4300	*f*	2	1	1	$7\frac{1}{4}$	$9\frac{9}{20}$	$14\frac{1}{2}$	$2\frac{1}{4}$	$4\frac{15}{20}$	1	—	165	1	18	27	84
4800	*g*	3	1	1	$8\frac{1}{4}$	$10\frac{7}{20}$	$23\frac{1}{2}$	$2\frac{1}{2}$	5	$1\frac{1}{4}$	$3\frac{13}{20}$	165	$1\frac{1}{16}$	$20\frac{3}{10}$	$30\frac{4}{10}$	$95\frac{1}{4}$
5300	*h*	3	1	1	10	12	$28\frac{1}{2}$	$3\frac{3}{4}$	$6\frac{3}{20}$	$1\frac{3}{4}$	$4\frac{4}{20}$	195	$1\frac{2}{16}$	$22\frac{3}{4}$	$34\frac{1}{8}$	$126\frac{1}{4}$
5900	*i*	3	1	1	12	$13\frac{17}{20}$	$34\frac{1}{4}$	4	$6\frac{7}{20}$	2	$4\frac{10}{20}$	195	$1\frac{3}{16}$	$25\frac{3}{8}$	38	$141\frac{1}{4}$
6500	*j*	3	1	1	$13\frac{1}{2}$	$15\frac{3}{20}$	$38\frac{1}{2}$	$4\frac{3}{4}$	$7\frac{2}{20}$	$2\frac{1}{2}$	5	210	$1\frac{4}{16}$	$28\frac{1}{8}$	$42\frac{1}{8}$	168
7100	*k*	3	1	1	$15\frac{1}{4}$	$16\frac{14}{20}$	$43\frac{1}{2}$	$5\frac{1}{4}$	$7\frac{11}{20}$	$2\frac{1}{2}$	5	210	$1\frac{5}{16}$	31	$46\frac{1}{2}$	$185\frac{1}{2}$
7700	*l*	3	1	1	17	$18\frac{5}{20}$	$48\frac{1}{2}$	$5\frac{1}{2}$	$7\frac{16}{20}$	$2\frac{3}{4}$	$5\frac{5}{20}$	240	$1\frac{6}{16}$	34	51	$232\frac{1}{4}$
8400	*m*	3	1	1	19	$19\frac{17}{20}$	54	$6\frac{1}{2}$	$8\frac{15}{20}$	$3\frac{1}{4}$	$5\frac{14}{20}$	240	$1\frac{7}{16}$	$37\frac{1}{8}$	$55\frac{5}{8}$	$254\frac{1}{4}$
9200	*n*	3	1	1	21	$21\frac{12}{20}$	60	$7\frac{1}{4}$	$9\frac{9}{20}$	$3\frac{1}{2}$	$5\frac{18}{20}$	240	$1\frac{8}{16}$	$40\frac{5}{10}$	$58\frac{7}{10}$	$276\frac{3}{4}$
10100	*o*	3	1	1	$23\frac{1}{2}$	$23\frac{10}{20}$	67	8	$10\frac{2}{20}$	4	$6\frac{7}{20}$	270	$1\frac{9}{16}$	$43\frac{9}{10}$	$61\frac{4}{10}$	336
11100	*p*	3	1	1	$25\frac{1}{2}$	$25\frac{3}{20}$	$72\frac{3}{4}$	$8\frac{1}{2}$	$10\frac{12}{20}$	$4\frac{1}{4}$	$6\frac{12}{20}$	270	$1\frac{10}{16}$	$47\frac{5}{10}$	$66\frac{5}{10}$	$359\frac{1}{2}$
12300	*q*	3	1	1	$27\frac{3}{4}$	$26\frac{18}{20}$	79	$8\frac{3}{4}$	$10\frac{17}{20}$	$4\frac{1}{2}$	$6\frac{17}{20}$	270	$1\frac{11}{16}$	$51\frac{1}{4}$	$71\frac{3}{4}$	$387\frac{3}{4}$
13600	*r*	3	1	1	30	$28\frac{12}{20}$	$85\frac{1}{2}$	$9\frac{1}{2}$	$11\frac{11}{20}$	$4\frac{3}{4}$	$7\frac{2}{20}$	270	$1\frac{12}{16}$	$55\frac{1}{8}$	$77\frac{1}{8}$	$416\frac{3}{4}$
15100	*s*	3	1	1	32	$30\frac{2}{20}$	$91\frac{1}{4}$	$10\frac{1}{2}$	$12\frac{8}{20}$	$5\frac{1}{4}$	$7\frac{11}{20}$	270	$1\frac{13}{16}$	$59\frac{1}{8}$	$82\frac{3}{4}$	$447\frac{1}{2}$
16800	*t*	3	1	1	34	$31\frac{12}{20}$	97	$10\frac{3}{4}$	$12\frac{13}{20}$	$5\frac{1}{2}$	$7\frac{16}{20}$	270	$1\frac{14}{16}$	$63\frac{1}{4}$	$88\frac{5}{10}$	$478\frac{1}{2}$
18600	*u*	3	1	1	$36\frac{1}{2}$	$33\frac{8}{20}$	104	$11\frac{1}{4}$	$13\frac{2}{20}$	$5\frac{1}{2}$	$7\frac{16}{20}$	270	$1\frac{15}{16}$	$67\frac{5}{10}$	$94\frac{5}{10}$	$511\frac{1}{2}$
20500	*v*	3	1	1	38	$34\frac{10}{20}$	$108\frac{1}{4}$	$11\frac{1}{2}$	$13\frac{7}{20}$	$5\frac{3}{4}$	8	270	2	72	$100\frac{8}{10}$	$538\frac{3}{4}$
22700	*w*	3	1	1	40	$35\frac{15}{20}$	114	12	$13\frac{17}{20}$	6	$8\frac{5}{20}$	270	$2\frac{1}{16}$	$76\frac{5}{10}$	$107\frac{1}{10}$	$573\frac{3}{4}$
25200	*x*	3	1	1	42	$37\frac{2}{20}$	$119\frac{3}{4}$	$13\frac{1}{2}$	$15\frac{3}{20}$	$6\frac{3}{4}$	9	300	$2\frac{3}{16}$	$86\frac{1}{8}$	$120\frac{5}{10}$	$717\frac{1}{2}$
27900	*y*	3	1	1	45	$39\frac{5}{20}$	$128\frac{1}{4}$	$15\frac{1}{4}$	$16\frac{14}{20}$	$7\frac{1}{2}$	$9\frac{13}{20}$	300	$2\frac{5}{16}$	$96\frac{1}{4}$	$134\frac{3}{4}$	801
30800	*z*	3	1	1	48	$41\frac{2}{20}$	137	17	$18\frac{5}{20}$	$8\frac{1}{2}$	$10\frac{12}{20}$	300	$2\frac{6}{16}$	$101\frac{1}{2}$	$142\frac{1}{10}$	$844\frac{1}{4}$

* Where the equipment number lies between any two consecutive numbers given in the Table the equipment is to be governed by the greater.

ANCHORS and CHAINS for SAILING VESSELS.

TABLE 54
(Concluded.)

* EQUIPMENT NUMBER.	Letters for Equipment as inserted in Register Book. Column 8	STREAM, CHAIN OR STEEL WIRE.						TOWLINE HEMP OR STEEL WIRE.				HAWSERS AND WARPS. HEMP OR STEEL WIRE.						
			Chain.			Flexible Steel Wire Rope.			Hemp.	Flexible Steel Wire Rope.			Hawsers.			Warps.		
		Length.	Size.	Minimum Weight.		Size. (*b*)	Breaking Test.	Length.	Size.	Size. (*b*)	Breaking Test.	Length of Each.	Number.	Hemp.	Flexible Steel Wire Rope.	Number.	Hemp.	Flexible Steel Wire Rope.
				Stud Link.	Short Link.									Size.	Size. (*b*)		Size.	Size. (*b*)
		Fathoms.	Inches	Cwts.	Cwts.	Inches.	Tons.	Fathoms.	Inches.	Inches.	Tons.	Fathoms		Inches.	Inches.		Inches.	Inches.
2100	*a*	45	$\frac{7}{16}$	$5\frac{1}{4}$	$5\frac{3}{4}$	—	—	75	5	$1\frac{3}{4}$	6·4	90	1	3	—	—	—	—
2500	*b*	45	$\frac{8}{16}$	$6\frac{1}{2}$	$7\frac{1}{4}$	—	—	75	$5\frac{1}{2}$	2	8·3	90	1	3	—	—	—	—
3000	*c*	45	$\frac{8}{16}$	$6\frac{1}{2}$	$7\frac{1}{4}$	—	—	75	$5\frac{1}{2}$	2	8·3	90	1	3	—	—	—	—
3400	*d*	45	$\frac{8}{16}$	$6\frac{1}{2}$	$7\frac{1}{4}$	—	—	75	6	$2\frac{1}{4}$	10·8	90	1	$3\frac{1}{2}$	—	—	—	—
3900	*e*	45	$\frac{9}{16}$	8	$8\frac{3}{4}$	2	8·3	75	$6\frac{1}{2}$	$2\frac{1}{4}$	10·8	90	1	4	—	—	—	—
4300	*f*	45	$\frac{9}{16}$	8	$8\frac{3}{4}$	2	8·3	75	$6\frac{1}{2}$	$2\frac{1}{4}$	10·8	90	1	4	—	—	—	—
4800	*g*	45	$\frac{10}{16}$	$9\frac{3}{4}$	$10\frac{1}{2}$	$2\frac{1}{4}$	10·8	75	7	$2\frac{1}{2}$	13·2	90	1	4	—	—	—	—
5300	*h*	45	$\frac{10}{16}$	$9\frac{3}{4}$	$10\frac{1}{2}$	$2\frac{1}{4}$	10·8	75	$7\frac{1}{2}$	$2\frac{1}{2}$	13·2	90	1	5	$1\frac{3}{4}$	—	—	—
5900	*i*	60	$\frac{11}{16}$	$14\frac{1}{2}$	$15\frac{3}{4}$	$2\frac{3}{4}$	15·2	75	8	$2\frac{3}{4}$	15·2	90	1	$5\frac{1}{2}$	2	—	—	—
6500	*j*	60	$\frac{11}{16}$	$14\frac{1}{2}$	$15\frac{3}{4}$	$2\frac{3}{4}$	15·2	75	8	$2\frac{3}{4}$	15·2	90	1	$5\frac{1}{2}$	2	—	—	—
7100	*k*	60	$\frac{12}{16}$	$17\frac{1}{4}$	$18\frac{3}{4}$	$2\frac{3}{4}$	15·2	75	$8\frac{1}{2}$	$2\frac{3}{4}$	15·2	90	1	6	$2\frac{1}{4}$	—	—	—
7700	*l*	60	$\frac{12}{16}$	$17\frac{1}{4}$	$18\frac{3}{4}$	$2\frac{3}{4}$	15·2	75	9	3	18·6	90	1	$6\frac{1}{2}$	$2\frac{1}{4}$	—	—	—
8400	*m*	60	$\frac{13}{16}$	$20\frac{1}{4}$	22	3	18·6	75	—	$3\frac{1}{4}$	21·7	90	1	7	$2\frac{1}{2}$	—	—	—
9200	*n*	60	$\frac{13}{16}$	$20\frac{1}{4}$	22	3	18·6	90	—	$3\frac{1}{4}$	21·7	90	1	7	$2\frac{1}{2}$	1	4	—
10100	*o*	60	$\frac{14}{16}$	$23\frac{1}{2}$	$25\frac{1}{2}$	$3\frac{1}{4}$	21·7	90	—	$3\frac{1}{4}$	21·7	90	1	8	$2\frac{3}{4}$	1	5	$1\frac{3}{4}$
11100	*p*	75	$\frac{14}{16}$	$29\frac{1}{4}$	$31\frac{1}{2}$	$3\frac{1}{4}$	21·7	90	—	$3\frac{1}{4}$	21·7	90	1	8	$2\frac{3}{4}$	1	5	$1\frac{3}{4}$
12300	*q*	75	$\frac{15}{16}$	34	$36\frac{1}{2}$	$3\frac{1}{2}$	25·7	90	—	$3\frac{1}{4}$	21·7	90	1	9	3	1	$5\frac{1}{2}$	2
13600	*r*	75	$\frac{15}{16}$	34	$36\frac{1}{2}$	$3\frac{1}{2}$	25·7	90	—	$3\frac{1}{4}$	21·7	90	1	9	3	1	$5\frac{1}{2}$	2
15100	*s*	75	1	$38\frac{1}{4}$	$41\frac{1}{4}$	$3\frac{3}{4}$	29·3	90	—	$3\frac{1}{2}$	25·7	90	1	—	$3\frac{1}{4}$	1	6	$2\frac{1}{4}$
16800	*t*	75	1	$38\frac{1}{4}$	$41\frac{1}{4}$	$3\frac{3}{4}$	29·3	90	—	$3\frac{1}{2}$	25·7	90	1	—	$3\frac{1}{4}$	1	6	$2\frac{1}{4}$
18600	*u*	75	$1\frac{1}{16}$	$43\frac{1}{4}$	$46\frac{1}{4}$	4	33·2	90	—	$3\frac{1}{2}$	25·7	90	1	—	$3\frac{1}{4}$	1	$6\frac{1}{2}$	$2\frac{1}{4}$
20500	*v*	75	$1\frac{1}{16}$	$43\frac{1}{4}$	$46\frac{1}{4}$	4	33·2	90	—	4	33·2	90	1	—	$3\frac{1}{2}$	1	7	$2\frac{1}{2}$
22700	*w*	100	$1\frac{2}{16}$	$64\frac{3}{4}$	$69\frac{1}{2}$	$4\frac{1}{4}$	36·4	90	—	4	33·2	90	1	—	$3\frac{1}{2}$	1	7	$2\frac{1}{2}$
25200	*x*	120	$1\frac{2}{16}$	$77\frac{3}{4}$	$83\frac{1}{2}$	$4\frac{1}{4}$	36·4	90	—	$4\frac{1}{2}$	43·3	90	1	—	4	1	8	$2\frac{3}{4}$
27900	*y*	120	$1\frac{3}{16}$	87	93	$4\frac{1}{2}$	43·3	90	—	$4\frac{1}{2}$	43·3	90	1	—	4	1	8	$2\frac{3}{4}$
30800	*z*	120	$1\frac{4}{16}$	96	103	$4\frac{3}{4}$	47·0	120	—	$4\frac{3}{4}$	47·0	90	1	—	$4\frac{1}{2}$	1	9	3

* Where the equipment number lies between any two consecutive numbers given in the Table the equipment is to be governed by the greater.

(*b*) 6 × 12 Flexible Steel Wire Ropes.

EQUIPMENT for TUGS. TABLE 55

*SECOND LONGITUDINAL NUMERAL L×(B+D)	ANCHORS. Number.	ANCHORS. Weight Ex Stock. 1st Bower.	ANCHORS. Weight Ex Stock. 2nd Bower.	ANCHORS. Weight Stockless. 1st Bower.	ANCHORS. Weight Stockless. 2nd Bower.	WROUGHT IRON CHAIN. Length.	WROUGHT IRON CHAIN. Diameter.	WROUGHT IRON CHAIN. Minimum Weight. Stud Link.	WROUGHT IRON CHAIN. Minimum Weight. Short Link.	HAWSERS. Length.	HAWSERS. Size.	WARPS. Length.	WARPS. Size.
		Cwts.	Cwts.	Cwts.	Cwts.	Fathoms.	Inches.	Cwts.	Cwts.	Fathoms.	Inches.	Fathoms.	Inches.
1440	2	2¼	2¼	3	3	60	10/16	13	14	60	4½	60	2½
1710	2	2½	2½	3¼	3¼	60	11/16	14½	15¾	60	4½	60	2½
1980	2	2¾	2¾	3½	3½	60	11/16	14½	15¾	60	4½	60	2½
2250	2	3	3	3¾	3¾	60	12/16	17¼	18¾	60	5	60	2½
2620	2	3½	3½	4½	4½	60	13/16	20½	22	60	5½	60	3
2950	2	4	4	5	5	60	14/16	23½	25½	60	5½	60	3
3230	2	4¼	4	5¼	5	60	14/16	23½	25½	60	5½	60	3½
3510	2	4½	4	5½	5	75	15/16	34	36½	60	5½	60	3½
3790	2	4¾	4¼	6	5¼	90	15/16	40¾	43¾	60	5½	60	4
4040	2	5	4½	6¼	5½	90	1	46	49½	60	5½	60	4
4290	2	5¼	4¾	6½	6	90	1	46	49½	60	6	60	4½
4530	2	5½	5	7	6¼	105	1 1/16	60¾	65	60	6	60	4½
4770	2	5¾	5¼	7¼	6½	105	1 1/16	60¾	65	60	6	60	5
5010	2	6	5½	7½	7	120	1 2/16	77¾	83½	60	6	60	5
5260	2	6¼	5¾	8	7¼	120	1 2/16	77¾	83½	60	6	60	5
5570	2	6½	6	8¼	7½	120	1 2/16	77¾	83½	60	6	60	5
5900	2	6¾	6¼	8½	8	120	1 3/16	87	93¼	60	7	60	5
6200	2	7	6½	8¾	8¼	120	1 3/16	87	93¼	60	7	60	5½
6560	2	7¼	6¾	9	8½	135	1 3/16	97¾	104¾	60	7	60	5½
6890	2	7½	7	9¼	8¾	135	1 3/16	97¾	104¾	60	7	60	5½
7220	2	7¾	7¼	9½	9	150	1 3/16	108½	116½	60	7	60	5½
7550	2	8	7½	10	9½	150	1 4/16	120	128½	60	7	60	5½

* Where the equipment number lies between any two consecutive numbers given in the Table the equipment is to be governed by the greater.

LLOYD'S REGISTER OF SHIPPING, LONDON.—17*th October*, 1946.

RENEWAL of CHAIN CABLES when WORN. TABLE 56

When any length of a Chain Cable is so worn that the mean diameter at its most worn part is reduced to the size given in the following Table, it is to be renewed.

ORIGINAL DIAMETER OF CHAIN CABLE.	MEAN DIAMETER REQUIRING RENEWAL OF CHAIN CABLE.	ORIGINAL DIAMETER OF CHAIN CABLE.	MEAN DIAMETER REQUIRING RENEWAL OF CHAIN CABLE.	ORIGINAL DIAMETER OF CHAIN CABLE.	MEAN DIAMETER REQUIRING RENEWAL OF CHAIN CABLE.	ORIGINAL DIAMETER OF CHAIN CABLE.	MEAN DIAMETER REQUIRING RENEWAL OF CHAIN CABLE.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
11/16	10/16	1 4/16	1 2/16	1 13/16	1 10/16	2 6/16	2 2/16
12/16	21/32	1 5/16	1 3/16	1 14/16	1 11/16	2 7/16	2 3/16
13/16	23/32	1 6/16	1 7/32	1 15/16	1 23/32	2 8/16	2 4/16
14/16	25/32	1 7/16	1 9/32	2	1 25/32	2 9/16	2 9/32
15/16	27/32	1 8/16	1 11/32	2 1/16	1 27/32	2 10/16	2 11/32
1	29/32	1 9/16	1 13/32	2 2/16	1 29/32	2 11/16	2 13/32
1 1/16	15/16	1 10/16	1 15/32	2 3/16	1 31/32	2 12/16	2 15/32
1 2/16	1	1 11/16	1 8/16	2 4/16	2	2 13/16	2 17/32
1 3/16	1 1/16	1 12/16	1 9/16	2 5/16	2 1/16	2 14/16	2 9/16

LLOYD'S REGISTER OF SHIPPING, LONDON.—13*th July*, 1922.

TABLES

OF

SCANTLINGS FOR VESSELS INTENDED TO CARRY PETROLEUM IN BULK.

(See pages 95—110.)

The scantlings of sectional materials used in the Tables are British Standard Sections. Where it is proposed to use sectional materials complying with the revised British Standards described on pages 527-529 of the Rules, the Committee will be prepared to accept scantlings for such sections on the basis of equivalent strength.

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BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 8 FEET.

TABLE 1

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		30	32	34	36	38	40
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
16	Plate Face Angle	26 × ·36 3½ × 3½ × ·40	26 × ·36 3½ × 3½ × ·40	27 × ·36 4 × 3½ × ·44			
18	Plate Face Angle		28 × ·36 3½ × 3½ × ·40	28 × ·36 4 × 3½ × ·48	28 × ·36 5 × 3½ × ·50	29 × ·38 5 × 3½ × ·54	
20	Plate Face Angle			28 × ·38 5 × 3½ × ·48	28 × ·38 5 × 3½ × ·54	29 × ·38 5 × 4 × ·54	30 × ·38 6 × 4 × ·52
22	Plate Face Angle				29 × ·38 5 × 3½ × ·54	30 × ·38 5 × 4 × ·54	30 × ·38 6 × 4 × ·56
24	Plate Face Angle						31 × ·40 6 × 4 × ·52
26	Plate Face Angle						
28	Plate Face Angle						

½ DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		42	44	46	48	50	52
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
22	Plate Face Angle	32 × ·40 6 × 4 × ·56	33 × ·40 6 × 4 × ·60				
24	Plate Face Angle or Bulb Angle	32 × ·40 6 × 4 × ·58	33 × ·40 6 × 4 × ·62	34 × ·42 7 × 3½ × ·54			
26	Plate Face Angle or Bulb Angle	33 × ·42 6 × 4 × ·56	34 × ·42 6 × 4 × ·58	34 × ·42 7 × 3½ × ·58	35 × ·42 8 × 3½ × ·54	36 × ·42 8 × 3½ × ·56	
28	Plate Face Bulb Angle			35 × ·44 7 × 3½ × ·56	36 × ·44 8 × 3½ × ·52	37 × ·44 8 × 3½ × ·54	39 × ·44 8 × 3½ × ·50
30	Plate Face Bulb Angle				36 × ·44 8 × 3½ × ·54	38 × ·44 8 × 3½ × ·52	40 × ·44 8 × 3½ × ·50
32	Plate Face Bulb Angle						41 × ·46 8 × 3½ × ·50

BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 8 FEET.

TABLE 1

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		54	56	58	60	62	64
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
30	Plate	41 × ·46	42 × ·46				
	Face Bulb Angle	8 × 3½ × ·54	8 × 3½ × ·56				
32	Plate	42 × ·46	43 × ·46	44 × ·46			
	Face Bulb Angle	8 × 3½ × ·50	8 × 3½ × ·52	8 × 3½ × ·56			
34	Plate	42 × ·46	43 × ·46	44 × ·46	46 × ·46	48 × ·46	
	Face Bulb Angle	8 × 3½ × ·52	8 × 3½ × ·54	8 × 3½ × ·58	8 × 3½ × ·56	8 × 3½ × ·54	
36	Plate			46 × ·46	47 × ·46	49 × ·46	50 × ·48
	Face Bulb Angle			8 × 3½ × ·52	8 × 3½ × ·56	8 × 3½ × ·54	8 × 3½ × ·58
38	Plate				48 × ·48	50 × ·48	51 × ·48
	Face Bulb Angle				8 × 3½ × ·56	8 × 3½ × ·54	8 × 3½ × ·56
40	Plate					51 × ·48	52 × ·48
	Face Bulb Angle					8 × 3½ × ·54	8 × 3½ × ·56
42	Plate						53 × ·50
	Face Bulb Angle						8 × 3½ × ·56

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		66	68	70	72	74	76
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
36	Plate						
	Face Bulb Angle						
38	Plate	53 × ·48	54 × ·48				
	Face Bulb Angle	8 × 3½ × ·56	9 × 3½ × ·52				
40	Plate	54 × ·48	55 × ·50	56 × ·50			
	Face Bulb Angle	9 × 3½ × ·50	9 × 3½ × ·52	9 × 3½ × ·56			
42	Plate	54 × ·50	56 × ·50	57 × ·50	58 × ·50		
	Face Bulb Angle	9 × 3½ × ·52	9 × 3½ × ·52	9 × 3½ × ·54	9 × 3½ × ·58		
44	Plate	55 × ·50	56 × ·50	58 × ·50	59 × ·50	60 × ·50	
	Face Bulb Angle	9 × 3½ × ·52	9 × 3½ × ·56	9 × 3½ × ·54	9 × 3½ × ·56	9 × 3½ × ·60	
46	Plate	56 × ·50	57 × ·50	59 × ·50	60 × ·50	61 × ·50	62 × ·50
	Face Bulb Angle	9 × 3½ × ·52	9 × 3½ × ·56	9 × 3½ × ·54	9 × 3½ × ·56	9 × 3½ × ·58	9 × 3½ × ·62

BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 10 FEET.

TABLE 1

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		30	32	34	36	38	40
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
16	Plate	27 × ·36	27 × ·36	28 × ·36			
	Face Angle	5 × 3½ × ·44	5 × 3½ × ·46	5 × 3½ × ·50			
18	Plate		28 × ·36	29 × ·38	30 × ·38	31 × ·38	
	Face Angle		5 × 3½ × ·50	5 × 4 × ·52	5 × 4 × ·56	6 × 4 × ·56	
20	Plate			30 × ·38	30 × ·38	32 × ·40	32 × ·40
	Face Angle			5 × 4 × ·52	6 × 4 × ·54	6 × 4 × ·54	6 × 4 × ·56
22	Plate				31 × ·38	32 × ·40	34 × ·42
	Face Angle				6 × 4 × ·52	6 × 4 × ·56	6 × 4 × ·58
24	Plate						35 × ·42
	Face Angle						6 × 4 × ·56
26	Plate						
	Face Angle						
28	Plate						
	Face Angle						

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		42	44	46	48	50	52
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
22	Plate	35 × ·42	36 × ·42				
	Face Angle or Bulb Angle	6 × 4 × ·62	7 × 3½ × ·58				
24	Plate	36 × ·42	37 × ·44	38 × ·44			
	Face Angle or Bulb Angle	6 × 4 × ·58	7 × 3½ × ·54	7 × 3½ × ·56			
26	Plate	36 × ·42	37 × ·44	38 × ·44	39 × ·44	40 × ·44	
	Face Angle or Bulb Angle	6 × 4 × ·60	7 × 3½ × ·56	8 × 3½ × ·52	8 × 3½ × ·56	9 × 3½ × ·54	
28	Plate			39 × ·44	40 × ·44	41 × ·46	42 × ·46
	Face Bulb Angle			8 × 3½ × ·50	8 × 3½ × ·54	9 × 3½ × ·52	9 × 3½ × ·56
30	Plate				40 × ·46	41 × ·46	42 × ·46
	Face Bulb Angle				8 × 3½ × ·56	9 × 3½ × ·56	9 × 3½ × ·60
32	Plate						43 × ·46
	Face Bulb Angle						9 × 3½ × ·56

BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 10 FEET.

TABLE 1

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		54	56	58	60	62	64
Feet. 30	Plate Face Bulb Angle	Inches. 43 × ·46 9 × 3½ × ·64	Inches. 45 × ·46 9 × 3½ × ·62	Inches.	Inches.	Inches.	Inches.
32	Plate Face Bulb Angle	44 × ·46 9 × 3½ × ·60	46 × ·46 9 × 3½ × ·58	47 × ·46 9 × 3½ × ·60			
34	Plate Face Bulb Angle or Double Angle	44 × ·46 9 × 3½ × ·62	46 × ·46 9 × 3½ × ·60	47 × ·46 9 × 3½ × ·64	49 × ·46 9 × 3½ × ·64	50 × ·48 5 × 4 × ·52	
36	Plate Double Face Angle			48 × ·48 5 × 4 × ·50	49 × ·48 5 × 4 × ·52	51 × ·48 5 × 4 × ·52	52 × ·48 5 × 4 × ·54
38	Plate Double Face Angle				50 × ·48 5 × 4 × ·52	52 × ·48 5 × 4 × ·52	52 × ·48 5 × 4 × ·56
40	Plate Double Face Angle					52 × ·48 6 × 4 × ·50	53 × ·48 6 × 4 × ·52
42	Plate Double Face Angle						54 × ·50 6 × 4 × ·52

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		66	68	70	72	74	76
Feet. 36	Plate Double Face Angle	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
38	Plate Double Face Angle	54 × ·48 6 × 4 × ·52	55 × ·50 6 × 4 × ·54				
40	Plate Double Face Angle	55 × ·50 6 × 4 × ·52	56 × ·50 6 × 4 × ·54	58 × ·50 6 × 4 × ·54			
42	Plate Double Face Angle	55 × ·50 6 × 4 × ·54	57 × ·50 6 × 4 × ·54	59 × ·50 6 × 4 × ·54	60 × ·50 6 × 4 × ·56		
44	Plate Double Face Angle	56 × ·50 6 × 4 × ·54	58 × ·50 6 × 4 × ·54	60 × ·50 6 × 4 × ·54	61 × ·50 6 × 4 × ·56	62 × ·50 6 × 4 × ·58	
46	Plate Double Face Angle	57 × ·50 6 × 4 × ·54	59 × ·50 6 × 4 × ·54	61 × ·50 6 × 4 × ·54	62 × ·50 6 × 4 × ·56	63 × ·50 6 × 4 × ·58	64 × ·50 6 × 4 × ·60

BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 12 FEET.

TABLE 1

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		30	32	34	36	38	40
Feet. 16	Plate	Inches. 28 × ·36	Inches. 28 × ·36	Inches. 29 × ·38	Inches.	Inches.	Inches.
	Face Angle	4 × 3½ × ·48	5 × 4 × ·54	6 × 4 × ·54			
18	Plate		29 × ·38	30 × ·38	31 × ·38	32 × ·40	
	Face Angle or Bulb Angle		5 × 4 × ·56	6 × 4 × ·58	6 × 4 × ·62	7 × 3½ × ·60	
20	Plate			31 × ·40	32 × ·40	33 × ·40	34 × ·42
	Face Angle or Bulb Angle			6 × 4 × ·56	6 × 4 × ·60	7 × 3½ × ·58	8 × 3½ × ·54
22	Plate				32 × ·40	33 × ·40	35 × ·42
	Face Angle or Bulb Angle				6 × 4 × ·62	7 × 3½ × ·60	8 × 3½ × ·52
24	Plate						35 × ·42
	Face Bulb Angle						8 × 3½ × ·54
26	Plate						
	Face Bulb Angle						
28	Plate						
	Face Bulb Angle						

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		42	44	46	48	50	52
Feet. 22	Plate	Inches. 36 × ·42	Inches. 37 × ·42	Inches.	Inches.	Inches.	Inches.
	Face Bulb Angle	8 × 3½ × ·56	8 × 3½ × ·64				
24	Plate	37 × ·44	38 × ·44	39 × ·44			
	Face Bulb Angle	8 × 3½ × ·54	8 × 3½ × ·58	9 × 3½ × ·58			
26	Plate	37 × ·44	39 × ·44	40 × ·44	41 × ·46	42 × ·46	
	Face Bulb Angle	8 × 3½ × ·56	8 × 3½ × ·56	9 × 3½ × ·56	9 × 3½ × ·60	9 × 3½ × ·66	
28	Plate			41 × ·46	42 × ·46	43 × ·46	44 × ·46
	Face Bulb Angle or Double Angle			9 × 3½ × ·56	9 × 3½ × ·60	9 × 3½ × ·64	5 × 4 × ·52
30	Plate				42 × ·46	44 × ·46	45 × ·46
	Face Bulb Angle or Double Angle				9 × 3½ × ·64	9 × 3½ × ·64	5 × 4 × ·52
32	Plate						45 × ·46
	Double Face Angle						6 × 4 × ·50

BOTTOM TRANSVERSES.

SPACING OF TRANSVERSES 12 FEET.

TABLE 1 *(Concluded.)*

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		54	56	58	60	62	64
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
30	Plate	46 × ·46	47 × ·46				
	Double Face Angle	6 × 4 × ·50	6 × 4 × ·52				
32	Plate	46 × ·46	48 × ·46	49 × ·46			
	Double Face Angle	6 × 4 × ·52	6 × 4 × ·50	6 × 4 × ·52			
34	Plate	47 × ·46	48 × ·46	49 × ·46	50 × ·48	52 × ·48	
	Double Face Angle	6 × 4 × ·50	6 × 4 × ·52	6 × 4 × ·54	6 × 4 × ·56	6 × 4 × ·56	
36	Plate			50 × ·48	51 × ·48	53 × ·48	55 × ·50
	Double Face Angle			6 × 4 × ·52	6 × 4 × ·56	6 × 4 × ·58	6 × 4 × ·58
38	Plate				52 × ·48	54 × ·48	56 × ·50
	Double Face Angle				6 × 4 × ·56	6 × 4 × ·58	6 × 4 × ·58
40	Plate						57 × ·50
	Double Face Angle						6 × 4 × ·58
42	Plate						58 × ·50
	Double Face Angle						6 × 4 × ·58

DEPTH. D	PLATE AND FACE BAR.	MOULDED BREADTH B OF VESSEL IN FEET.					
		66	68	70	72	74	76
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
36	Plate						
	Double Face Angle						
38	Plate	57 × ·50	59 × ·50				
	Double Face Angle	6 × 4 × ·60	6 × 4 × ·60				
40	Plate	58 × ·50	60 × ·50	62 × ·50			
	Double Face Angle	6 × 4 × ·60	6 × 4 × ·60	6 × 4 × ·62			
42	Plate	59 × ·50	61 × ·50	63 × ·50	65 × ·50		
	Double Face Angle	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62		
44	Plate	60 × ·50	62 × ·50	64 × ·50	66 × ·50	68 × ·50	
	Double Face Angle	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	
46	Plate	61 × ·50	63 × ·50	65 × ·50	67 × ·50	69 × ·50	71 × ·50
	Double Face Angle	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62	6 × 4 × ·62

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		7	8	9	10	11	12	13	14	15
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
15	Plate	14 × ·36	14 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
16	Plate	14 × ·36	14 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
17	Plate	14 × ·36	14 × ·36	15 × ·36						
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36						
18	Plate		14 × ·36	15 × ·36	16 × ·36					
	Face Angle ..		3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36					
19	Plate		15 × ·36	15 × ·36	16 × ·36					
	Face Angle ..		3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36					
20	Plate			15 × ·38	16 × ·38	16 × ·38				
	Face Angle ..			3 × 3 × ·38	3 × 3 × ·38	3½ × 3½ × ·38				
21	Plate			16 × ·38	17 × ·38	17 × ·38	18 × ·38			
	Face Angle ..			3 × 3 × ·38	3 × 3 × ·38	3½ × 3½ × ·40	4 × 3½ × ·38			
22	Plate				17 × ·38	18 × ·38	18 × ·38	19 × ·38		
	Face Angle ..				3½ × 3½ × ·38	3½ × 3½ × ·40	4 × 3½ × ·40	4 × 3½ × ·40		
23	Plate					18 × ·40	19 × ·40	20 × ·40		
	Face Angle ..					3½ × 3½ × ·40	4 × 3½ × ·40	4 × 3½ × ·40		
24	Plate						20 × ·40	20 × ·42	21 × ·42	
	Face Angle ..						4 × 3½ × ·40	4 × 3½ × ·42	4 × 3½ × ·42	
25	Plate						20 × ·42	21 × ·42	22 × ·42	23 × ·42
	Face Angle ..						4 × 3½ × ·42	4 × 3½ × ·42	4 × 3½ × ·42	4 × 3½ × ·42
26	Plate							22 × ·42	23 × ·42	24 × ·42
	Face Angle ..							4 × 3½ × ·42	4 × 3½ × ·42	4 × 3½ × ·42
27	Plate								23 × ·42	24 × ·42
	Face Angle ..								4 × 3½ × ·44	4 × 3½ × ·44
28	Plate									25 × ·44
	Face Angle ..									4 × 3½ × ·44

SIDE TRANSVERSES BELOW SECOND DECK.

TABLE 2

SPACING OF TRANSVERSES 8 FEET.

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		16	17	18	19	20	21	22	23	24
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	Plate	24 × ·42								
	Face Angle ..	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$								
27	Plate	25 × ·44	25 × ·44							
	Face Angle ..	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$							
28	Plate	25 × ·44	25 × ·44	26 × ·46						
	Face Angle ..	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	5 × $3\frac{1}{2} \times \cdot 50$	5 × $3\frac{1}{2} \times \cdot 50$						
29	Plate	26 × ·44	26 × ·46	27 × ·46	27 × ·46					
	Face Angle ..	$4\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	5 × $3\frac{1}{2} \times \cdot 50$	5 × $3\frac{1}{2} \times \cdot 50$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$					
30	Plate		26 × ·46	27 × ·46	28 × ·46	29 × ·46				
	Face Angle ..		5 × $3\frac{1}{2} \times \cdot 52$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 52$				
31	Plate			28 × ·46	29 × ·46	29 × ·46	30 × ·46			
	Face Angle ..			$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$			
32	Plate				29 × ·46	30 × ·46	30 × ·46	31 × ·46		
	Face Angle ..				$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 56$	6 × $3\frac{1}{2} \times \cdot 56$		
33	Plate				30 × ·46	30 × ·46	31 × ·46	32 × ·46	33 × ·46	
	Face Angle ..				$5\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	
34	Plate					31 × ·46	32 × ·46	32 × ·48	33 × ·48	
	Face Angle ..					6 × $3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	
35	Plate					31 × ·46	32 × ·46	33 × ·48	34 × ·48	35 × ·48
	Face Angle ..					6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 52$	6 × $3\frac{1}{2} \times \cdot 56$
36	Plate						33 × ·46	34 × ·48	34 × ·48	35 × ·48
	Face Angle ..						6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 54$	6 × $3\frac{1}{2} \times \cdot 56$	6 × $3\frac{1}{2} \times \cdot 60$
37	Plate							34 × ·48	35 × ·48	36 × ·48
	Face Angle ..							$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$
38	Plate								36 × ·48	36 × ·48
	Face Angle ..								$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$6\frac{1}{2} \times 4 \times \cdot 54$
39	Plate								36 × ·48	37 × ·48
	Face Angle ..								$6\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$6\frac{1}{2} \times 4 \times \cdot 54$
40	Plate									37 × ·48
	Face Angle ..									$6\frac{1}{2} \times 4 \times \cdot 56$

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		25	26	27	28	29	30	31	32	33
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
32	Plate									
	Face Angle ..									
33	Plate									
	Face Angle ..									
34	Plate									
	Face Angle ..									
35	Plate									
	Face Angle ..									
36	Plate	36 × ·48								
	Face Angle ..	6 × 3½ × ·60								
37	Plate	36 × ·48								
	Face Angle ..	6½ × 3½ × ·60								
38	Plate	37 × ·48	37 × ·48							
	Face Angle ..	6½ × 3½ × ·58	6½ × 3½ × ·60							
39	Plate	37 × ·48	38 × ·48	39 × ·48						
	Face Angle ..	6½ × 4 × ·58	6½ × 4 × ·58	6½ × 4 × ·58						
40	Plate	38 × ·48	38 × ·48	39 × ·48	40 × ·48					
	Face Angle ..	6½ × 4 × ·56	6½ × 4 × ·60	6½ × 4 × ·60	6½ × 4 × ·60					
41	Plate	38 × ·48	39 × ·48	40 × ·48	41 × ·48	42 × ·48				
	Face Angle ..	6½ × 4 × ·58	6½ × 4 × ·58	6½ × 4 × ·60	6½ × 4 × ·60	6½ × 4 × ·60				
42	Plate		39 × ·50	40 × ·50	41 × ·50	42 × ·50	43 × ·50			
	Face Angle ..		6½ × 4 × ·60	6½ × 4 × ·60	6½ × 4 × ·62	6½ × 4 × ·62	6½ × 4 × ·62			
43	Plate			40 × ·50	41 × ·50	42 × ·50	43 × ·50	44 × ·50		
	Face Angle ..			6½ × 4 × ·64	6½ × 4 × ·64	6½ × 4 × ·64	6½ × 4 × ·64	6½ × 4 × ·64		
44	Plate				42 × ·50	43 × ·50	43 × ·50	44 × ·50	45 × ·50	
	Face Angle ..				6½ × 4 × ·62	6½ × 4 × ·62	6½ × 4 × ·68	6½ × 4 × ·68	6½ × 4 × ·70	
45	Plate					43 × ·50	44 × ·50	45 × ·50	46 × ·50	47 × ·50
	Face Angle ..					6½ × 4 × ·68	6½ × 4 × ·70	6½ × 4 × ·72	6½ × 4 × ·74	6½ × 4 × ·76

SIDE TRANSVERSES BELOW SECOND DECK.

TABLE 2

SPACING OF TRANSVERSES 10 FEET.

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		7	8	9	10	11	12	13	14	15
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
15	Plate	14 × ·36	14 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
16	Plate	14 × ·36	14 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
17	Plate	14 × ·36	15 × ·36	16 × ·36						
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36						
18	Plate		15 × ·36	16 × ·38	17 × ·38					
	Face Angle ..		3 × 3 × ·36	3 × 3 × ·38	3 × 3 × ·38					
19	Plate		16 × ·38	17 × ·38	18 × ·38					
	Face Angle ..		3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38					
20	Plate			17 × ·38	18 × ·38	18 × ·38				
	Face Angle ..			3 × 3 × ·42	3½ × 3½ × ·38	4 × 3½ × ·38				
21	Plate			18 × ·38	19 × ·38	19 × ·38	20 × ·38			
	Face Angle ..			3 × 3 × ·42	3½ × 3½ × ·38	4 × 3½ × ·38	4½ × 3½ × ·38			
22	Plate				19 × ·38	20 × ·38	20 × ·38	21 × ·40		
	Face Angle ..				3½ × 3½ × ·40	4 × 3½ × ·38	4½ × 3½ × ·40	4½ × 3½ × ·40		
23	Plate					20 × ·40	21 × ·40	22 × ·40		
	Face Angle ..					4 × 3½ × ·40	4½ × 3½ × ·40	4½ × 3½ × ·40		
24	Plate						22 × ·40	22 × ·42	23 × ·42	
	Face Angle ..						4½ × 3½ × ·40	4½ × 3½ × ·42	4½ × 3½ × ·44	
25	Plate						22 × ·42	23 × ·42	24 × ·42	25 × ·44
	Face Angle ..						4½ × 3½ × ·42	4½ × 3½ × ·42	4½ × 3½ × ·42	4½ × 3½ × ·44
26	Plate							24 × ·42	25 × ·42	26 × ·44
	Face Angle ..							4½ × 3½ × ·42	4½ × 3½ × ·42	4½ × 3½ × ·44
27	Plate								25 × ·44	26 × ·44
	Face Angle ..								4½ × 3½ × ·44	5 × 3½ × ·44
28	Plate									27 × ·44
	Face Angle ..									5 × 3½ × ·44

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		16	17	18	19	20	21	22	23	24
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	Plate	26 × ·44								
	Face Angle ..	5 × 3½ × ·44								
27	Plate	27 × ·44	27 × ·44							
	Face Angle ..	5 × 3½ × ·44	5½ × 3½ × ·48							
28	Plate	27 × ·44	27 × ·46	28 × ·46						
	Face Angle ..	5½ × 3½ × ·44	6 × 3½ × ·50	6 × 3½ × ·50						
29	Plate	28 × ·46	28 × ·46	29 × ·46	29 × ·46					
	Face Angle ..	5½ × 3½ × ·44	6 × 3½ × ·50	6 × 3½ × ·50	6 × 3½ × ·56					
30	Plate		28 × ·46	29 × ·46	30 × ·46	31 × ·46				
	Face Angle ..		6 × 3½ × ·52	6 × 3½ × ·52	6 × 3½ × ·54	6½ × 3½ × ·54				
31	Plate			30 × ·46	31 × ·46	31 × ·46	32 × ·46			
	Face Angle ..			6 × 3½ × ·50	6 × 3½ × ·54	6½ × 3½ × ·56	6½ × 4 × ·60			
32	Plate				31 × ·46	32 × ·46	32 × ·46	33 × ·46		
	Face Angle ..				6 × 3½ × ·56	6½ × 4 × ·56	6½ × 4 × ·60	6½ × 4 × ·60		
33	Plate				32 × ·46	32 × ·46	33 × ·46	34 × ·46	35 × ·46	
	Face Angle ..				6 × 3½ × ·54	6½ × 4 × ·58	6½ × 4 × ·60	6½ × 4 × ·60	6½ × 4 × ·64	
34	Plate					33 × ·46	34 × ·46	34 × ·46	35 × ·46	
	Face Angle ..					6½ × 4 × ·56	6½ × 4 × ·60	6½ × 4 × ·60	6½ × 4 × ·64	
35	Plate					33 × ·46	34 × ·46	35 × ·46	36 × ·46	37 × ·46
	Face Angle ..					6½ × 4 × ·56	6½ × 4 × ·60	6½ × 4 × ·62	6½ × 4 × ·62	6½ × 4 × ·62
36	Plate						35 × ·48	36 × ·48	36 × ·48	37 × ·48
	Face Angle ..						6½ × 4 × ·58	6½ × 4 × ·60	6½ × 4 × ·64	6½ × 4 × ·64
37	Plate							36 × ·48	37 × ·48	38 × ·48
	Face Angle ..							6½ × 4 × ·62	6½ × 4 × ·62	6½ × 4 × ·62
38	Plate								38 × ·48	38 × ·48
	Face Angle ..								6½ × 4 × ·62	7 × 4 × ·62
39	Plate								38 × ·48	39 × ·48
	Face Angle ..								6½ × 4 × ·64	7 × 4 × ·62
40	Plate									39 × ·48
	Face Angle ..									7 × 4 × ·64

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		25	26	27	28	29	30	31	32	33
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
32	Plate									
	Face Angle ..									
33	Plate									
	Face Angle ..									
34	Plate									
	Face Angle ..									
35	Plate									
	Face Angle ..									
36	Plate	38 × ·48								
	Face Angle ..	6½ × 4 × ·64								
37	Plate	38 × ·48								
	Face Angle ..	6½ × 4 × ·66								
38	Plate	39 × ·48	39 × ·48							
	Face Angle ..	7 × 4 × ·62	7 × 4 × ·64							
39	Plate	39 × ·48	39 × ·48							
	Face Angle ..	7 × 4 × ·64	7 × 4 × ·66							
40	Plate	40 × ·48	40 × ·48	41 × ·48	42 × ·48					
	Face Angle ..	7 × 4 × ·64	7 × 4 × ·66	7 × 4 × ·66	7 × 4 × ·68					
41	Plate	40 × ·48	41 × ·48	42 × ·48	43 × ·48	44 × ·48				
	Face Angle ..	7 × 4 × ·66	7 × 4 × ·66	7 × 4 × ·66	7 × 4 × ·68	7 × 4 × ·70				
42	Plate		41 × ·50	42 × ·50	43 × ·50	44 × ·50	45 × ·50			
	Face Angle ..		7 × 4 × ·68	7 × 4 × ·68	7 × 4 × ·70	7 × 4 × ·70	7 × 4 × ·72			
43	Plate			42 × ·50	43 × ·50	44 × ·50	45 × ·50	46 × ·50		
	Face Angle ..			7 × 4 × ·70	7 × 4 × ·70	7 × 4 × ·72	7 × 4 × ·74	7 × 4 × ·74		
44	Plate				44 × ·50	45 × ·50	45 × ·50	46 × ·50	47 × ·50	
	Face Angle ..				7 × 4 × ·70	7 × 4 × ·72	7 × 4 × ·76	7 × 4 × ·76	7 × 4 × ·76	
45	Plate					45 × ·50	46 × ·50	47 × ·50	48 × ·50	49 × ·50
	Face Angle ..					7 × 4 × ·74	7 × 4 × ·76	7 × 4 × ·76	7 × 4 × ·76	7 × 4 × ·78

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		7	8	9	10	11	12	13	14	15
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
15	Plate	15 × ·36	15 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
16	Plate	15 × ·36	15 × ·36							
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36							
17	Plate	15 × ·38	16 × ·38	17 × ·38						
	Face Angle ..	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38						
18	Plate		16 × ·38	17 × ·38	18 × ·38					
	Face Angle ..		3 × 3 × ·38	3 × 3 × ·40	3 × 3 × ·40					
19	Plate		17 × ·38	18 × ·38	19 × ·38					
	Face Angle ..		3 × 3 × ·38	3 × 3 × ·40	3½ × 3½ × ·38					
20	Plate			19 × ·38	20 × ·38	20 × ·38				
	Face Angle ..			3 × 3 × ·40	3½ × 3½ × ·38	4 × 3½ × ·40				
21	Plate				21 × ·40	21 × ·40	21 × ·40			
	Face Angle ..				3½ × 3½ × ·40	4 × 3½ × ·40	4½ × 3½ × ·42			
22	Plate				21 × ·40	22 × ·40	22 × ·40	23 × ·40		
	Face Angle ..				3½ × 3½ × ·42	4 × 3½ × ·40	4½ × 3½ × ·42	4½ × 3½ × ·42		
23	Plate					22 × ·42	23 × ·42	24 × ·42		
	Face Angle ..					4 × 3½ × ·40	4½ × 3½ × ·42	4½ × 3½ × ·42		
24	Plate						24 × ·42	24 × ·44	25 × ·44	
	Face Angle ..						4½ × 3½ × ·44	5 × 3½ × ·44	5 × 3½ × ·44	
25	Plate						24 × ·44	25 × ·44	26 × ·44	27 × ·44
	Face Angle ..						5 × 3½ × ·42	5 × 3½ × ·44	5 × 3½ × ·44	5 × 3½ × ·44
26	Plate							26 × ·44	27 × ·46	28 × ·46
	Face Angle ..							5 × 3½ × ·44	5 × 3½ × ·46	5 × 3½ × ·46
27	Plate								27 × ·46	28 × ·46
	Face Angle ..								5 × 3½ × ·48	5½ × 3½ × ·46
28	Plate									29 × ·46
	Face Angle ..									5½ × 3½ × ·46

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 2

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		16	17	18	19	20	21	22	23	24
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
26	Plate	28 × ·46								
	Face Angle ..	5½ × 3½ × ·48								
27	Plate	29 × ·46	29 × ·46							
	Face Angle ..	5½ × 3½ × ·46	6 × 3½ × ·50							
28	Plate	29 × ·46	29 × ·46	30 × ·46						
	Face Angle ..	5½ × 3½ × ·48	6 × 3½ × ·54	6 × 3½ × ·54						
29	Plate	30 × ·46	30 × ·46	31 × ·46	31 × ·46					
	Face Angle ..	5½ × 3½ × ·46	6 × 3½ × ·54	6 × 3½ × ·54	6½ × 3½ × ·58					
30	Plate		30 × ·46	31 × ·46	32 × ·46	33 × ·46	33 × ·46			
	Face Angle ..		6½ × 3½ × ·54	6½ × 3½ × ·54	6½ × 3½ × ·58	6½ × 4 × ·56	7 × 4 × ·62			
31	Plate			32 × ·46	33 × ·46	33 × ·46	34 × ·46	35 × ·46		
	Face Angle ..			6½ × 3½ × ·54	6½ × 3½ × ·56	6½ × 4 × ·58	7 × 4 × ·62	7 × 4 × ·62		
32	Plate				33 × ·46	34 × ·46	34 × ·46	35 × ·46		
	Face Angle ..				6½ × 3½ × ·58	6½ × 4 × ·58	7 × 4 × ·64	7 × 4 × ·66		
33	Plate				34 × ·46	34 × ·46	35 × ·46	36 × ·46	37 × ·46	
	Face Angle ..				6½ × 3½ × ·58	6½ × 4 × ·60	7 × 4 × ·62	7 × 4 × ·64	7 × 4 × ·64	
34	Plate					35 × ·46	36 × ·46	36 × ·48	37 × ·48	
	Face Angle ..					6½ × 4 × ·60	7 × 4 × ·62	7 × 4 × ·64	7 × 4 × ·64	
35	Plate					35 × ·48	36 × ·48	37 × ·48	38 × ·48	39 × ·48
	Face Angle ..					6½ × 4 × ·60	6 × 4 × ·62	7 × 4 × ·62	7 × 4 × ·62	7 × 4 × ·66
36	Plate					36 × ·48	37 × ·48	38 × ·48	38 × ·48	39 × ·48
	Face Angle ..					6½ × 4 × ·60	7 × 4 × ·60	7 × 4 × ·60	7 × 4 × ·64	7 × 4 × ·68
37	Plate							38 × ·48	39 × ·48	40 × ·48
	Face Angle ..							7 × 4 × ·62	7 × 4 × ·64	7 × 4 × ·66
38	Plate								40 × ·48	40 × ·48
	Face Angle ..								7 × 4 × ·62	7 × 4 × ·64
39	Plate								40 × ·48	41 × ·48
	Face Angle ..								7 × 4 × ·64	7 × 4 × ·68
40	Plate									41 × ·48
	Face Angle ..									7 × 4 × ·70

SIDE TRANSVERSES BELOW SECOND DECK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 2 *(Concluded.)*

DEPTH. D	PLATE AND FACE BAR.	DEPTH (d) IN FEET AT MIDDLE OF LENGTH FROM TOP OF BOTTOM TRANSVERSES AT CENTRE TO LOWEST DECK AT SIDE.								
		25	26	27	28	29	30	31	32	33
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
32	Plate									
	Face Angle									
33	Plate									
	Face Angle									
34	Plate									
	Face Angle									
35	Plate									
	Face Angle									
36	Plate	40 × ·48								
	Face Angle	7 × 4 × ·68								
37	Plate	40 × ·48								
	Face Angle	7 × 4 × ·70								
38	Plate	41 × ·48	41 × ·48							
	Face Angle	7 × 4 × ·70	7 × 4 × ·72							
39	Plate	41 × ·48	41 × ·48							
	Face Angle	7 × 4 × ·72	7 × 4 × ·74							
40	Plate	42 × ·48	42 × ·48	43 × ·48	44 × ·48					
	Face Angle	7 × 4 × ·70	7 × 4 × ·74	7 × 4 × ·74	7 × 4 × ·76					
41	Plate	42 × ·50	43 × ·50	44 × ·50	45 × ·50	45 × ·50				
	Face Angle	7 × 4 × ·70	7 × 4 × ·72	7 × 4 × ·74	7 × 4 × ·76	7 × 4 × ·78				
42	Plate		43 × ·50	44 × ·50	45 × ·50	46 × ·50	47 × ·50			
	Double Face Angles		5 × 3½ × ·50	5 × 3½ × ·50	5 × 3½ × ·52	5 × 3½ × ·52	5 × 3½ × ·52			
43	Plate			44 × ·50	45 × ·50	46 × ·50	47 × ·50	47 × ·50		
	Double Face Angles			5 × 3½ × ·52	5 × 3½ × ·54	5 × 3½ × ·54	5½ × 3½ × ·54	5½ × 3½ × ·56		
44	Plate					47 × ·50	47 × ·50	48 × ·50	49 × ·50	
	Double Face Angles					5 × 3½ × ·54	5½ × 3½ × ·54	5½ × 3½ × ·56	5½ × 3½ × ·58	
45	Plate					47 × ·50	48 × ·50	49 × ·50	50 × ·50	51 × ·50
	Double Face Angles					5 × 3½ × ·56	5½ × 3½ × ·54	5½ × 3½ × ·56	5½ × 3½ × ·58	6 × 3½ × ·58

TABLE 3

STIFFENING ANGLES to TRANSVERSES.

DEPTH OF BOTTOM TRANSVERSE.	STIFFENING ANGLES.
Inches.	Inches.
Not exceeding 30	5 × 3 × ·36
,, 36	6 × 3 × ·38
,, 40	6 × 3½ × ·40
44 and above.	6 × 3½ × ·44

DEPTH OF SIDE TRANSVERSE.	SHORT STIFFENING ANGLES.	LONG STIFFENING ANGLES.
Inches.	Inches.	Inches.
Not exceeding 18	3 × 3 × ·36	5 × 3 × ·36
,, 24	3 × 3 × ·38	6 × 3 × ·38
,, 28	3½ × 3½ × ·40	6 × 3½ × ·40
32 and above.	3½ × 3½ × ·44	6 × 3½ × ·44

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SIDE TRANSVERSES in 'TWEEN DECKS.

TABLE 4

(See Continuation.)

DEPTH. D	PLATE AND FACE BAR.	SPACING OF TRANSVERSES.								
		Feet. 8			Feet. 10			Feet. 12		
		HEIGHT OF 'TWEEN DECKS.								
		Feet. 7	Feet. 8	Feet. 9	Feet. 7	Feet. 8	Feet. 9	Feet. 7	Feet. 8	Feet. 9
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches	Inches.
15	Plate	13 × ·36	13 × ·36	13 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36
16	Plate	13 × ·36	13 × ·36	13 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·36
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36
17	Plate	13 × ·36	13 × ·36	13 × ·36	14 × ·36	14 × ·36	14 × ·36	14 × ·38	14 × ·38	14 × ·38
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
18	Plate	13 × ·36	13 × ·36	13 × ·36	14 × ·38	14 × ·38	14 × ·38	14 × ·38	14 × ·38	14 × ·38
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
19	Plate	14 × ·36	14 × ·36	14 × ·36	14 × ·38	14 × ·38	14 × ·38	14 × ·38	14 × ·38	14 × ·38
	Face Angle ..	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·36	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
20	Plate	14 × ·38	14 × ·38	14 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38
	Face Angle ..	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
21	Plate	14 × ·38	14 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38
	Face Angle ..	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
22	Plate	14 × ·38	14 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38	15 × ·38
	Face Angle ..	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38	3 × 3 × ·38
23	Plate	14 × ·38	15 × ·38	16 × ·38	15 × ·38	16 × ·38	16 × ·38	15 × ·38	16 × ·38	16 × ·38
	Face Angle ..	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·38
24	Plate	15 × ·38	16 × ·38	17 × ·38	15 × ·38	16 × ·38	17 × ·38	15 × ·38	16 × ·38	17 × ·38
	Face Angle ..	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·40	3½ × 3½ × ·38	3½ × 3½ × ·38	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40
25	Plate	16 × ·38	17 × ·38	18 × ·38	16 × ·38	17 × ·38	18 × ·38	16 × ·40	17 × ·40	18 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40
26	Plate	16 × ·38	17 × ·40	19 × ·40	16 × ·38	17 × ·40	19 × ·40	16 × ·40	17 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·38	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42
27	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42
28	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42
29	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42
30	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42

SIDE TRANSVERSES in 'TWEEN DECKS.

TABLE 4 *(Concluded.)*

DEPTH. D	PLATE AND FACE BAR.	SPACING OF TRANSVERSES.								
		Feet. 8			Feet. 10			Feet. 12		
		HEIGHT OF 'TWEEN DECKS.								
		Feet. 7	Feet. 8	Feet. 9	Feet. 7	Feet. 8	Feet. 9	Feet. 7	Feet. 8	Feet. 9
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
31	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
32	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
33	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
34	Plate	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40	17 × ·40	18 × ·40	19 × ·40
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
35	Plate	18 × ·40	19 × ·40	20 × ·40	18 × ·40	19 × ·40	20 × ·40	18 × ·42	19 × ·42	20 × ·42
	Face Angle ..	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·40	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
36	Plate	18 × ·42	19 × ·42	20 × ·42	18 × ·42	19 × ·42	20 × ·42	18 × ·42	19 × ·42	20 × ·42
	Face Angle ..	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44
37	Plate	18 × ·42	19 × ·42	20 × ·42	18 × ·42	19 × ·42	20 × ·44	18 × ·44	19 × ·44	20 × ·44
	Face Angle ..	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·42	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	4 × 3½ × ·44
38	Plate	18 × ·44	19 × ·44	20 × ·44	18 × ·42	19 × ·44	20 × ·44	18 × ·44	19 × ·44	20 × ·44
	Face Angle ..	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	3½ × 3½ × ·44	4 × 3½ × ·44	3½ × 3½ × ·44	4 × 3½ × ·46	4 × 3½ × ·46
39	Plate	18 × ·44	19 × ·44	20 × ·44	18 × ·44	19 × ·44	20 × ·44	18 × ·44	19 × ·44	20 × ·44
	Face Angle ..	3½ × 3½ × ·44	3½ × 3½ × ·44	4 × 3½ × ·44	4 × 3½ × ·44	4 × 3½ × ·46	4 × 3½ × ·46	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·46
40	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	19 × ·44	20 × ·44	21 × ·44
	Face Angle ..	4 × 3½ × ·44	4 × 3½ × ·44	4 × 3½ × ·46	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·46	4½ × 3½ × ·44	4½ × 3½ × ·46	4½ × 3½ × ·48
41	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	19 × ·44	20 × ·44	21 × ·44
	Face Angle ..	4 × 3½ × ·44	4 × 3½ × ·44	4 × 3½ × ·46	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·46	4½ × 3½ × ·44	4½ × 3½ × ·46	4½ × 3½ × ·48
42	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	19 × ·44	20 × ·44	21 × ·44
	Face Angle ..	4 × 3½ × ·44	4 × 3½ × ·44	4 × 3½ × ·46	4 × 3½ × ·44	4 × 3½ × ·46	4½ × 3½ × ·46	4½ × 3½ × ·44	4½ × 3½ × ·46	4½ × 3½ × ·48
43	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	20 × ·44	21 × ·44	22 × ·44
	Face Angle ..	4½ × 3½ × ·44	4½ × 3½ × ·44	4½ × 3½ × ·46	5 × 3½ × ·44	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·48
44	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	20 × ·44	21 × ·44	22 × ·44
	Face Angle ..	4½ × 3½ × ·44	4½ × 3½ × ·44	4½ × 3½ × ·46	5 × 3½ × ·44	5 × 3½ × ·44	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·48
45	Plate	18 × ·44	19 × ·44	20 × ·44	19 × ·44	20 × ·44	21 × ·44	20 × ·44	21 × ·44	22 × ·44
	Face Angle ..	4½ × 3½ × ·44	4½ × 3½ × ·44	4½ × 3½ × ·46	5 × 3½ × ·44	5 × 3½ × ·44	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·46	5 × 3½ × ·48

UPPER DECK TRANSVERSES.

TRANSVERSES IN SUMMER TANKS. TABLE 5

BREADTH OF SHIP. B	PLATE AND FACE BAR.	SPACING OF TRANSVERSES. Feet. 8	Feet. 10	Feet. 12
Feet.		Inches.	Inches.	Inches.
30	Plate	10 × ·36	10 × ·38	11 × ·38
	Face Bar	3 × 3 × ·36	3 × 3 × ·38	$3\frac{1}{2} \times 3\frac{1}{2} \times ·40$
40	Plate	11 × ·38	11 × ·38	11 × ·40
	Face Bar	3 × 3 × ·38	$3\frac{1}{2} \times 3\frac{1}{2} \times ·38$	4 × $3\frac{1}{2}$ × ·40
50	Plate	11 × ·40	11 × ·40	12 × ·40
	Face Bar	$3\frac{1}{2} \times 3\frac{1}{2} \times ·40$	4 × $3\frac{1}{2}$ × ·40	$4\frac{1}{2} \times 3\frac{1}{2} \times ·40$
60	Plate	12 × ·40	12 × ·40	13 × ·40
	Face Bar	4 × $3\frac{1}{2}$ × ·40	$4\frac{1}{2} \times 3\frac{1}{2} \times ·40$	$5\frac{1}{2} \times 3\frac{1}{2} \times ·40$
70	Plate	13 × ·40	14 × ·40	15 × ·40
	Face Bar	5 × $3\frac{1}{2}$ × ·40	$5\frac{1}{2} \times 3\frac{1}{2} \times ·46$	6 × $3\frac{1}{2}$ × ·50

TRANSVERSES IN EXPANSION TRUNK. TABLE 6

BREADTH OF SHIP. B	PLATE AND FACE BAR.	SPACING OF TRANSVERSES. Feet. 8	Feet. 10	Feet. 12
Feet.		Inches.	Inches.	Inches.
30	Plate	10 × ·36	12 × ·36	14 × ·36
	Breadth of Flange ..	5	5	5
40	Plate	14 × ·36	15 × ·40	16 × ·40
	Breadth of Flange ..	5	5	5
50	Plate	16 × ·40	17 × ·40	18 × ·40
	Breadth of Flange ..	5	5	5
60	Plate	17 × ·40	18 × ·40	19 × ·40
	Breadth of Flange ..	5	5	5
70	Plate	18 × ·40	19 × ·40	20 × ·40
	Breadth of Flange ..	5	5	5

SECOND DECK TRANSVERSES. TABLE 7

BREADTH OF SHIP. B	PLATE AND FACE BAR.	SPACING OF TRANSVERSES. Feet. 8	Feet. 10	Feet. 12
Feet.		Inches.	Inches.	Inches.
30	Plate	12 × ·38	14 × ·40	16 × ·40
	Face Bar	$3\frac{1}{2} \times 3\frac{1}{2} \times ·44$	$4\frac{1}{2} \times 3\frac{1}{2} \times ·44$	5 × $3\frac{1}{2}$ × ·44
40	Plate	14 × ·40	16 × ·40	18 × ·40
	Face Bar	5 × $3\frac{1}{2}$ × ·50	$5\frac{1}{2} \times 3\frac{1}{2} \times ·50$	6 × $3\frac{1}{2}$ × ·50
50	Plate	16 × ·40	18 × ·40	20 × ·40
	Face Bar	$5\frac{1}{2} \times 3\frac{1}{2} \times ·50$	6 × $3\frac{1}{2}$ × ·50	6 × $3\frac{1}{2}$ × ·60
60	Plate	20 × ·40	22 × ·42	24 × ·42
	Face Bar	6 × $3\frac{1}{2}$ × ·50	6 × $3\frac{1}{2}$ × ·60	6 × $3\frac{1}{2}$ × ·70
70	Plate	24 × ·42	26 × ·44	28 × ·44
	Face Bar	6 × $3\frac{1}{2}$ × ·60	$6\frac{1}{2} \times 3\frac{1}{2} \times ·60$	$6\frac{1}{2} \times 3\frac{1}{2} \times ·70$

BOTTOM LONGITUDINALS where ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 8

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D	MOULDED DEPTH D OF VESSEL IN FEET.							
	15	16	17	18	19	20	21	22
3000	Inches. $9 \times 3\frac{1}{2} \times \cdot 50$	Inches. $9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	Inches. $9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	Inches. $9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	Inches.	Inches.	Inches.	Inches.
4000		$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$10 \times 3\frac{1}{2} \times \cdot 46$	$10 \times 3\frac{1}{2} \times \cdot 48$	$10 \times 3\frac{1}{2} \times \cdot 52$		
5000			$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$10 \times 3\frac{1}{2} \times \cdot 48$	$10 \times 3\frac{1}{2} \times \cdot 50$	$10 \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$
6000					$10 \times 3\frac{1}{2} \times \cdot 54$	$10 \times 3\frac{1}{2} \times \cdot 58$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$
7000							$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$11 \times 3\frac{1}{2} \times \cdot 48$
8000								
9000								
10000								
11000								

BULB ANGLES

FIRST LONGITUDINAL NUMERAL L × D	MOULDED DEPTH D OF VESSEL IN FEET.							
	23	24	25	26	27	28	29	30
6000	Inches. $10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	Inches. $11 \times 3\frac{1}{2} \times \cdot 50$	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
7000	$11 \times 3\frac{1}{2} \times \cdot 50$	$11 \times 3\frac{1}{2} \times \cdot 54$	$11 \times 3\frac{1}{2} \times \cdot 56$					
8000	$11 \times 3\frac{1}{2} \times \cdot 54$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$			
9000			$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$		
10000				$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 58$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 60$	$12 \times 3\frac{1}{2} \times \cdot 54$	
11000						$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 64$	$12 \times 3\frac{1}{2} \times \cdot 56$	$12 \times 3\frac{1}{2} \times \cdot 58$
12000							$12 \times 3\frac{1}{2} \times \cdot 60$	$12 \times 3\frac{1}{2} \times \cdot 62$
13000								$12 \times 3\frac{1}{2} \times \cdot 66$
14000								
15000								

BULB ANGLES

BOTTOM LONGITUDINALS where ONE TRANSVERSE in each TANK.

TABLE 8

SPACING OF TRANSVERSES 10 FEET.

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		31	32	33	34	35	36	37
11000	BULB ANGLES	Inches. $12\times3\frac{1}{2}\times\cdot60$	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	BULB ANGLES	$12\times3\frac{1}{2}\times\cdot64$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot50$					
13000	CHANNELS	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot50$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot54$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot56$				
14000	CHANNELS		$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot56$	$12\times3\frac{1}{2}\times3\frac{1}{2}\times\cdot58$	$12\times4\times4\times\cdot52$			
15000	CHANNELS			$12\times4\times4\times\cdot52$	$12\times4\times4\times\cdot54$	$12\times4\times4\times\cdot56$		
16000	CHANNELS				$12\times4\times4\times\cdot56$	$12\times4\times4\times\cdot58$	$13\times4\times4\times\cdot50$	
17000	CHANNELS					$13\times4\times4\times\cdot52$	$13\times4\times4\times\cdot54$	$13\times4\times4\times\cdot56$
18000	CHANNELS						$13\times4\times4\times\cdot56$	$13\times4\times4\times\cdot58$
19000	CHANNELS							$13\times4\times4\times\cdot62$

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.							
		38	39	40	41	42	43	44	45
17000	CHANNELS	Inches. $13\times4\times4\times\cdot58$	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18000	CHANNELS	$13\times4\times4\times\cdot60$	$14\times4\times4\times\cdot50$						
19000	CHANNELS	$13\times4\times4\times\cdot64$	$14\times4\times4\times\cdot54$	$14\times4\times4\times\cdot56$					
20000	CHANNELS		$14\times4\times4\times\cdot56$	$14\times4\times4\times\cdot58$	$15\times4\times4\times\cdot52$				
21000	CHANNELS			$14\times4\times4\times\cdot62$	$15\times4\times4\times\cdot56$	$15\times4\times4\times\cdot58$			
22000	CHANNELS				$15\times4\times4\times\cdot60$	$15\times4\times4\times\cdot62$	$15\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot44$		
23000	CHANNELS					$15\times4\times4\times\cdot66$	$16\times\cdot44$ $4\times3\frac{1}{2}\times\cdot44$		
24000	PLATE & FACE BAR.						$16\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	$16\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	
25000	PLATE & FACE BAR.						$16\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	$17\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	$17\times\cdot44$ $4\times3\frac{1}{2}\times\cdot48$
26000	PLATE & FACE BAR.							$17\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	$17\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot48$

The Scantlings of the Bar connecting the built type of Longitudinal to the Shell are to be the same as the Face Bar but the thickness of the Shell Bar need not exceed ·50 inch.

BOTTOM LONGITUDINALS where ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 8

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.							
		15	16	17	18	19	20	21	22
3000	BULB ANGLES	Inches. 11 × 3½ × ·48	Inches. 11 × 3½ × ·56	Inches. 11½ × 3½ × ·48	Inches. 11½ × 3½ × ·52	Inches.	Inches.	Inches.	Inches.
4000			11 × 3½ × ·58	11½ × 3½ × ·52	11½ × 3½ × ·56	11½ × 3½ × ·60	12 × 3½ × ·50		
5000				11½ × 3½ × ·56	11½ × 3½ × ·60	12 × 3½ × ·50	12 × 3½ × ·54	12 × 3½ × ·56	12 × 3½ × ·60
6000						12 × 3½ × ·54	12 × 3½ × ·58	12 × 3½ × ·60	12 × 3½ × 3½ × ·50
7000								12 × 3½ × ·64	12 × 3½ × 3½ × ·54
8000	CHANNELS								
9000									
10000									
11000									

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		23	24	25	26	27	28	29
6000	CHANNELS	Inches. 12 × 3½ × 3½ × ·50	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
7000		12 × 3½ × 3½ × ·54	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·50				
8000		12 × 3½ × 3½ × ·58	12 × 3½ × 3½ × ·60	12 × 4 × 4 × ·54	12 × 4 × 4 × ·56			
9000			12 × 4 × 4 × ·54	12 × 4 × 4 × ·58	12 × 4 × 4 × ·60	13 × 4 × 4 × ·50	13 × 4 × 4 × ·52	
10000					12 × 4 × 4 × ·64	13 × 4 × 4 × ·52	13 × 4 × 4 × ·54	13 × 4 × 4 × ·54
11000						13 × 4 × 4 × ·54	13 × 4 × 4 × ·56	13 × 4 × 4 × ·58
12000								13 × 4 × 4 × ·62
13000								
14000								
15000								

BOTTOM LONGITUDINALS where ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 8 *(Concluded.)*

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		30	31	32	33	34	35	36
11000	CHANNELS	Inches. 14×4×4×·50	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000		14×4×4×·52	14×4×4×·54					
13000		14×4×4×·54	14×4×4×·56	14×4×4×·58	15×4×4×·52			
14000			14×4×4×·60	14×4×4×·60	15×4×4×·54	15×4×4×·56		
15000				14×4×4×·62	15×4×4×·56	15×4×4×·58	15×4×4×·60	
16000					15×4×4×·60	15×4×4×·62	15×4×4×·64	15×4×4×·66
17000							15×4×4×·68	15×4×4×·70
18000								15×4×4×·74
19000								

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.								
		37	38	39	40	41	42	43	44	45
17000	CHANNELS	Inches. 15×4×4×·72	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18000	PLATE AND FACE BAR	17×·44 4×3½×·44	17 ×·44 4×3½×·46							
19000		17×·44 4×3½×·46	17½×·44 4×3½×·46	17½×·44 4×3½×·48						
20000			17½×·44 4×3½×·48	17½×·44 4×3½×·50	18 ×·44 4×3½×·50					
21000				18 ×·44 4×3½×·50	18½×·44 4×3½×·50	19×·46 4×3½×·48				
22000					19 ×·44 4×3½×·50	19×·46 4×3½×·52	19 ×·46 4×3½×·54			
23000						19×·46 4×3½×·54	19½×·46 4×3½×·54	20×·46 4×3½×·54		
24000							20 ×·46 4×3½×·52	20×·48 4×3½×·54	20×·48 4×3½×·56	20×·50 4×3½×·58
25000								20×·48 4×3½×·56	20×·50 4×3½×·56	20×·50 4×3½×·60
26000									20×·50 4×3½×·58	20×·50 4×3½×·62

The Scantlings of the Bar connecting the built type of Longitudinal to the Shell are to be the same as the Face Bar but the thickness of the Shell Bar need not exceed ·50 inch.

BOTTOM LONGITUDINALS where MORE than ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 9

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D	MOULDED DEPTH D OF VESSEL IN FEET.								
	15	16	17	18	19	20	21	22	23
3000	Inches. $9 \times 3\frac{1}{2} \times \cdot 44$	Inches. $9 \times 3\frac{1}{2} \times \cdot 52$	Inches. $9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	Inches. $9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	Inches.	Inches.	Inches.	Inches.	Inches.
4000		$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10 \times 3\frac{1}{2} \times \cdot 44$	$10 \times 3\frac{1}{2} \times \cdot 46$			
5000			$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$9\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$10 \times 3\frac{1}{2} \times \cdot 46$	$10 \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 44$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	
6000					$10 \times 3\frac{1}{2} \times \cdot 50$	$10 \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$
7000							$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$
8000									$10\frac{1}{2} \times 3\frac{1}{2} \times \cdot 60$
9000									
10000									
11000									

BULB ANGLES

FIRST LONGITUDINAL NUMERAL L × D	MOULDED DEPTH D OF VESSEL IN FEET.							
	24	25	26	27	28	29	30	31
6000	Inches. $11 \times 3\frac{1}{2} \times \cdot 48$	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
7000	$11 \times 3\frac{1}{2} \times \cdot 50$	$11 \times 3\frac{1}{2} \times \cdot 52$						
8000	$11 \times 3\frac{1}{2} \times \cdot 52$	$11 \times 3\frac{1}{2} \times \cdot 54$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 46$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$				
9000		$11 \times 3\frac{1}{2} \times \cdot 58$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 48$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 50$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$			
10000			$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 52$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 54$	$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 56$	$12 \times 3\frac{1}{2} \times \cdot 50$		
11000					$11\frac{1}{2} \times 3\frac{1}{2} \times \cdot 60$	$12 \times 3\frac{1}{2} \times \cdot 52$	$12 \times 3\frac{1}{2} \times \cdot 54$	$12 \times 3\frac{1}{2} \times \cdot 56$
12000						$12 \times 3\frac{1}{2} \times \cdot 56$	$12 \times 3\frac{1}{2} \times \cdot 58$	$12 \times 3\frac{1}{2} \times \cdot 60$
13000							$12 \times 3\frac{1}{2} \times \cdot 62$	$12 \times 3\frac{1}{2} \times \cdot 64$
14000								
15000								

BULB ANGLES

BOTTOM LONGITUDINALS where MORE than ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 9

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		32	33	34	35	36	37	38
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000	CHANNELS	12 × 3½ × 3½ × ·46						
13000		12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·52					
14000		12 × 3½ × 3½ × ·54	12 × 3½ × 3½ × ·56	12 × 4 × 4 × ·50				
15000			12 × 3½ × 3½ × ·58	12 × 4 × 4 × ·52	12 × 4 × 4 × ·52			
16000				12 × 4 × 4 × ·54	12 × 4 × 4 × ·56	13 × 4 × 4 × ·50		
17000					13 × 4 × 4 × ·50	13 × 4 × 4 × ·52	13 × 4 × 4 × ·52	13 × 4 × 4 × ·54
18000						13 × 4 × 4 × ·54	13 × 4 × 4 × ·56	13 × 4 × 4 × ·58
19000							13 × 4 × 4 × ·58	13 × 4 × 4 × ·60
20000								

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		39	40	41	42	43	44	45
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
17000	CHANNELS							
18000		14 × 4 × 4 × ·50						
19000		14 × 4 × 4 × ·52	14 × 4 × 4 × ·54					
20000		14 × 4 × 4 × ·56	14 × 4 × 4 × ·58	15 × 4 × 4 × ·52				
21000			14 × 4 × 4 × ·62	15 × 4 × 4 × ·56	15 × 4 × 4 × ·58			
22000				15 × 4 × 4 × ·60	15 × 4 × 4 × ·62	15½ × ·44 4 × 3½ × ·44		
23000					15 × 4 × 4 × ·66	16 × ·44 4 × 3½ × ·44		
24000	PLATE & FACE BAR.					16 × ·44 4 × 3½ × ·46	16½ × ·44 4 × 3½ × ·46	
25000						16½ × ·44 4 × 3½ × ·46	17 × ·44 4 × 3½ × ·46	17 × ·44 4 × 3½ × ·48
26000							17½ × ·44 4 × 3½ × ·46	17½ × ·44 4 × 3½ × ·48

The Scantlings of the Bar connecting the built type of Longitudinal to the Shell are to be the same as the Face Bar but the thickness of the Shell Bar need not exceed ·50 inch.

BOTTOM LONGITUDINALS where MORE than ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 9

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.							
		15	16	17	18	19	20	21	22
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000	BULB ANGLES	11 × 3½ × ·44	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·46				
4000	BULB ANGLES		11 × 3½ × ·54	11½ × 3½ × ·46	11½ × 3½ × ·50	11½ × 3½ × ·52	11½ × 3½ × ·56		
5000	BULB ANGLES			11½ × 3½ × ·50	11½ × 3½ × ·54	11½ × 3½ × ·56	12 × 3½ × ·50	12 × 3½ × ·52	12 × 3½ × ·54
6000	BULB ANGLES					11½ × 3½ × ·60	12 × 3½ × ·54	12 × 3½ × ·56	12 × 3½ × 3½ × ·46
7000	BULB ANGLES							12 × 3½ × ·60	12 × 3½ × 3½ × ·50
8000	CHANNELS								
9000	CHANNELS								
10000	CHANNELS								
11000	CHANNELS								

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		23	24	25	26	27	28	29
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
6000	CHANNELS	12 × 3½ × 3½ × ·48						
7000	CHANNELS	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·56				
8000	CHANNELS	12 × 3½ × 3½ × ·54	12 × 3½ × 3½ × ·56	12 × 3½ × 3½ × ·60	12 × 4 × 4 × ·54			
9000	CHANNELS		12 × 3½ × 3½ × ·60	12 × 4 × 4 × ·54	12 × 4 × 4 × ·56	12 × 4 × 4 × ·60	13 × 4 × 4 × ·48	
10000	CHANNELS				12 × 4 × 4 × ·60	13 × 4 × 4 × ·50	13 × 4 × 4 × ·52	13 × 4 × 4 × ·52
11000	CHANNELS					13 × 4 × 4 × ·52	13 × 4 × 4 × ·54	13 × 4 × 4 × ·56
12000	CHANNELS							13 × 4 × 4 × ·60
13000	CHANNELS							
14000	CHANNELS							
15000	CHANNELS							

BOTTOM LONGITUDINALS where MORE than ONE TRANSVERSE in each TANK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 9 *(Concluded.)*

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.						
		30	31	32	33	34	35	36
11000	CHANNELS ^	Inches. 14×4×4×·50	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
12000		14×4×4×·50	14×4×4×·52	14×4×4×·54				
13000		14×4×4×·52	14×4×4×·54	14×4×4×·56	15×4×4×·50			
14000			14×4×4×·58	14×4×4×·60	15×4×4×·52	15×4×4×·54		
15000				14×4×4×·62	15×4×4×·54	15×4×4×·56	15×4×4×·58	
16000					15×4×4×·58	15×4×4×·60	15×4×4×·62	15×4×4×·64
17000							15×4×4×·66 74.8	15×4×4×·68 76.1
18000								15×4×4×·72 78.9
19000	V							

FIRST LONGITUDINAL NUMERAL L × D		MOULDED DEPTH D OF VESSEL IN FEET.								
		37	38	39	40	41	42	43	44	45
17000	CHANNELS	Inches. 15×4×4×·70	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
18000	PLATE AND FACE BARS ^	$16\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot44$	$16\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$							
19000		$16\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	17 ×·44 $4\times3\frac{1}{2}\times\cdot46$	17 ×·44 $4\times3\frac{1}{2}\times\cdot48$						
20000			17 ×·44 $4\times3\frac{1}{2}\times\cdot48$	$17\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot48$	18 ×·44 $4\times3\frac{1}{2}\times\cdot46$					
21000				18 ×·44 $4\times3\frac{1}{2}\times\cdot48$	$18\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot46$	$18\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot48$				
22000					$18\frac{1}{2}\times\cdot44$ $4\times3\frac{1}{2}\times\cdot50$	19 ×·44 $4\times3\frac{1}{2}\times\cdot48$	19 ×·46 $4\times3\frac{1}{2}\times\cdot48$			
23000						19 ×·46 $4\times3\frac{1}{2}\times\cdot48$	$19\frac{1}{2}\times\cdot46$ $4\times3\frac{1}{2}\times\cdot48$	20×·46 $4\times3\frac{1}{2}\times\cdot48$		
24000							20 ×·46 $4\times3\frac{1}{2}\times\cdot50$	20×·48 $4\times3\frac{1}{2}\times\cdot50$	20×·48 $4\times3\frac{1}{2}\times\cdot52$	
25000								20×·48 $4\times3\frac{1}{2}\times\cdot54$	20×·50 $4\times3\frac{1}{2}\times\cdot54$	20×·50 $4\times3\frac{1}{2}\times\cdot56$
26000	V								20×·50 $4\times3\frac{1}{2}\times\cdot56$	20×·50 $4\times3\frac{1}{2}\times\cdot58$

The Scantlings of the Bar connecting the built type of Longitudinal to the Shell are to be the same as the Face Bar but the thickness of the Shell Bar need not exceed ·50 inch.

SIDE LONGITUDINALS where ONE TRANSVERSE is FITTED in EACH TANK.

SPACING OF TRANSVERSES 10 FEET.

TABLE 10

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		IN TWEEN DECKS.	DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.						
			10	12	14	16	18	20	22
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000	A	6 ×3 ×·34	6½ ×3 ×·38	7 ×3 ×·40					
4000		6 ×3 ×·36	7 ×3 ×·36	7 ×3 ×·40					
5000		6 ×3 ×·38	7 ×3 ×·38	7 ×3 ×·42	7½ ×3 ×·46				
6000		6½ ×3 ×·36	7 ×3 ×·40	7½ ×3 ×·40	8 ×3 ×·40	8 ×3 ×·44			
7000		6½ ×3½ ×·36	7 ×3½ ×·42	7½ ×3½ ×·40	8 ×3½ ×·40	8½ ×3½ ×·40	8½ ×3½ ×·42		
8000		6½ ×3½ ×·38	7 ×3½ ×·44	7½ ×3½ ×·42	8 ×3½ ×·42	8½ ×3½ ×·40	8½ ×3½ ×·44	9 ×3½ ×·40	
9000		6½ ×3½ ×·38	7 ×3½ ×·46	7½ ×3½ ×·44	8 ×3½ ×·42	8½ ×3½ ×·42	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·46
10000		6½ ×3½ ×·40	7½ ×3½ ×·38	7½ ×3½ ×·46	8 ×3½ ×·44	8½ ×3½ ×·42	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·46
11000		7 ×3½ ×·40	7½ ×3½ ×·38	8 ×3½ ×·40	8 ×3½ ×·46	8½ ×3½ ×·44	9 ×3½ ×·40	9 ×3½ ×·44	9 ×3½ ×·48
12000		7 ×3½ ×·40	7½ ×3½ ×·40	8 ×3½ ×·40	8 ×3½ ×·46	8½ ×3½ ×·44	9 ×3½ ×·40	9 ×3½ ×·46	9 ×3½ ×·50
13000		7 ×3½ ×·42	7½ ×3½ ×·40	8 ×3½ ×·42	8½ ×3½ ×·40	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·46	9½ ×3½ ×·42
14000		7 ×3½ ×·42	7½ ×3½ ×·42	8 ×3½ ×·42	8½ ×3½ ×·40	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·48	9½ ×3½ ×·44
15000		7 ×3½ ×·42	7½ ×3½ ×·44	8 ×3½ ×·44	8½ ×3½ ×·42	9 ×3½ ×·40	9 ×3½ ×·44	9 ×3½ ×·48	9½ ×3½ ×·44
16000		7½ ×3½ ×·40	7½ ×3½ ×·46	8 ×3½ ×·44	8½ ×3½ ×·44	9 ×3½ ×·40	9 ×3½ ×·44	9½ ×3½ ×·42	9½ ×3½ ×·46
17000		7½ ×3½ ×·40	7½ ×3½ ×·46	8 ×3½ ×·46	8½ ×3½ ×·44	9 ×3½ ×·42	9 ×3½ ×·46	9½ ×3½ ×·42	9½ ×3½ ×·46
18000		7½ ×3½ ×·42	8 ×3½ ×·40	8½ ×3½ ×·40	8½ ×3½ ×·46	9 ×3½ ×·44	9½ ×3½ ×·42	9½ ×3½ ×·44	9½ ×3½ ×·48
19000		7½ ×3½ ×·42	8 ×3½ ×·40	8½ ×3½ ×·42	8½ ×3½ ×·48	9 ×3½ ×·44	9½ ×3½ ×·42	9½ ×3½ ×·44	9½ ×3½ ×·48
20000		7½ ×3½ ×·44	8 ×3½ ×·42	8½ ×3½ ×·44	8½ ×3½ ×·48	9 ×3½ ×·46	9½ ×3½ ×·42	9½ ×3½ ×·46	9½ ×3½ ×·50
21000		8 ×3½ ×·40	8 ×3½ ×·42	8½ ×3½ ×·44	8½ ×3½ ×·50	9 ×3½ ×·46	9½ ×3½ ×·44	9½ ×3½ ×·48	9½ ×3½ ×·50
22000		8 ×3½ ×·40	8 ×3½ ×·44	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·48	9½ ×3½ ×·44	9½ ×3½ ×·48	9½ ×3½ ×·50
23000		8 ×3½ ×·42	8 ×3½ ×·44	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·48	9½ ×3½ ×·44	9½ ×3½ ×·48	10 ×3½ ×·44
24000		8 ×3½ ×·44	8½ ×3½ ×·44	8½ ×3½ ×·48	9 ×3½ ×·44	9½ ×3½ ×·42	9½ ×3½ ×·46	9½ ×3½ ×·50	10 ×3½ ×·44
25000		8 ×3½ ×·44	8½ ×3½ ×·44	9 ×3½ ×·42	9 ×3½ ×·46	9½ ×3½ ×·42	9½ ×3½ ×·46	10 ×3½ ×·44	10 ×3½ ×·46
26000	V	8½ ×3½ ×·42	8½ ×3½ ×·46	9 ×3½ ×·42	9 ×3½ ×·46	9½ ×3½ ×·44	9½ ×3½ ×·48	10 ×3½ ×·44	10 ×3½ ×·46

BULB ANGLES

SIDE LONGITUDINALS where ONE TRANSVERSE is FITTED in EACH TANK.

TABLE 10

(See Continuation.)

SPACING OF TRANSVERSES 10 FEET.

FIRST LONGITUDINAL NUMERAL L × D	DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.							
	24	26	28	30	32	34	36	38
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000								
4000								
5000								
6000								
7000								
8000								
9000								
10000								
11000								
12000	9½ × 3½ × ·44							
13000	9½ × 3½ × ·46	9½ × 3½ × ·50						
14000	9½ × 3½ × ·48	10 × 3½ × ·44	10 × 3½ × ·48					
15000	9½ × 3½ × ·48	10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·52				
16000	9½ × 3½ × ·50	10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·52				
17000	9½ × 3½ × ·50	10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·50			
18000	10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·50			
19000	10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·50	10½ × 3½ × ·46	10½ × 3½ × ·52			
20000	10 × 3½ × ·44	10 × 3½ × ·48	10½ × 3½ × ·44	10½ × 3½ × ·46	10½ × 3½ × ·52	11 × 3½ × ·44		
21000	10 × 3½ × ·46	10 × 3½ × ·50	10½ × 3½ × ·44	10½ × 3½ × ·48	10½ × 3½ × ·54	11 × 3½ × ·46	11 × 3½ × ·48	
22000	10 × 3½ × ·46	10 × 3½ × ·50	10½ × 3½ × ·44	10½ × 3½ × ·48	10½ × 3½ × ·54	11 × 3½ × ·46	11 × 3½ × ·50	
23000	10 × 3½ × ·48	10 × 3½ × ·52	10½ × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·54	11 × 3½ × ·48	11 × 3½ × ·50	
24000	10 × 3½ × ·48	10 × 3½ × ·52	10½ × 3½ × ·46	10½ × 3½ × ·50	10½ × 3½ × ·56	11 × 3½ × ·48	11 × 3½ × ·52	11½ × 3½ × ·46
25000	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·48	10½ × 3½ × ·54	10½ × 3½ × ·58	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·48
26000	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·48	10½ × 3½ × ·54	10½ × 3½ × ·58	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·50

BULB ANGLES

SIDE LONGITUDINALS where ONE TRANSVERSE is FITTED in EACH TANK.

SPACING OF TRANSVERSES 12 FEET.

TABLE 10

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D	IN 'TWEEN DECKS.	DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.						
		10	12	14	16	18	20	22
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000	6½ × 3 × ·34	7½ × 3 × ·40	8½ × 3 × ·40					
4000	7 × 3 × ·36	8 × 3 × ·42	8½ × 3 × ·42					
5000	7 × 3 × ·38	8 × 3 × ·44	8½ × 3 × ·44	9 × 3½ × ·46				
6000	7½ × 3 × ·38	8 × 3 × ·46	8½ × 3½ × ·46	9 × 3½ × ·48	9½ × 3½ × ·46			
7000	7½ × 3½ × ·38	8½ × 3½ × ·40	8½ × 3½ × ·46	9 × 3½ × ·48	9½ × 3½ × ·48	10 × 3½ × ·46		
8000	7½ × 3½ × ·38	8½ × 3½ × ·42	9 × 3½ × ·42	9½ × 3½ × ·42	10 × 3½ × ·44	10 × 3½ × ·48	10½ × 3½ × ·44	
9000	7½ × 3½ × ·40	8½ × 3½ × ·44	9 × 3½ × ·44	9½ × 3½ × ·44	10 × 3½ × ·44	10 × 3½ × ·48	10½ × 3½ × ·46	
10000	7½ × 3½ × ·40	8½ × 3½ × ·46	9 × 3½ × ·46	9½ × 3½ × ·46	10 × 3½ × ·46	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·46
11000	8 × 3½ × ·40	8½ × 3½ × ·48	9 × 3½ × ·48	9½ × 3½ × ·48	10 × 3½ × ·46	10 × 3½ × ·52	10½ × 3½ × ·50	11 × 3½ × ·46
12000	8 × 3½ × ·40	8½ × 3½ × ·48	9 × 3½ × ·48	9½ × 3½ × ·48	10 × 3½ × ·48	10½ × 3½ × ·46	10½ × 3½ × ·50	11 × 3½ × ·48
13000	8 × 3½ × ·42	9 × 3½ × ·42	9½ × 3½ × ·42	10 × 3½ × ·44	10 × 3½ × ·50	10½ × 3½ × ·46	11 × 3½ × ·44	11 × 3½ × ·48
14000	8 × 3½ × ·42	9 × 3½ × ·42	9½ × 3½ × ·44	10 × 3½ × ·44	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·44	11 × 3½ × ·50
15000	8 × 3½ × ·42	9 × 3½ × ·44	9½ × 3½ × ·46	10 × 3½ × ·46	10½ × 3½ × ·44	10½ × 3½ × ·50	11 × 3½ × ·46	11 × 3½ × ·50
16000	8½ × 3½ × ·40	9 × 3½ × ·46	9½ × 3½ × ·46	10 × 3½ × ·48	10½ × 3½ × ·46	10½ × 3½ × ·50	11 × 3½ × ·46	11 × 3½ × ·52
17000	8½ × 3½ × ·40	9 × 3½ × ·46	9½ × 3½ × ·48	10 × 3½ × ·48	10½ × 3½ × ·46	10½ × 3½ × ·52	11 × 3½ × ·48	11 × 3½ × ·52
18000	8½ × 3½ × ·42	9 × 3½ × ·48	9½ × 3½ × ·50	10 × 3½ × ·50	10½ × 3½ × ·48	10½ × 3½ × ·52	11 × 3½ × ·50	11½ × 3½ × ·46
19000	8½ × 3½ × ·42	9 × 3½ × ·48	10 × 3½ × ·44	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·44	11 × 3½ × ·50	11½ × 3½ × ·46
20000	8½ × 3½ × ·44	9½ × 3½ × ·42	10 × 3½ × ·46	10½ × 3½ × ·44	10½ × 3½ × ·50	11 × 3½ × ·46	11 × 3½ × ·52	11½ × 3½ × ·48
21000	9 × 3½ × ·42	9½ × 3½ × ·42	10 × 3½ × ·46	10½ × 3½ × ·44	11 × 3½ × ·44	11 × 3½ × ·46	11 × 3½ × ·52	11½ × 3½ × ·50
22000	9 × 3½ × ·44	9½ × 3½ × ·44	10 × 3½ × ·48	10½ × 3½ × ·46	11 × 3½ × ·46	11 × 3½ × ·48	11½ × 3½ × ·46	11½ × 3½ × ·52
23000	9 × 3½ × ·44	9½ × 3½ × ·44	10 × 3½ × ·48	10½ × 3½ × ·46	11 × 3½ × ·46	11 × 3½ × ·50	11½ × 3½ × ·46	11½ × 3½ × ·52
24000	9½ × 3½ × ·40	9½ × 3½ × ·46	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·48	11 × 3½ × ·52	11½ × 3½ × ·48	11½ × 3½ × ·54
25000	9½ × 3½ × ·44	9½ × 3½ × ·48	10 × 3½ × ·50	10½ × 3½ × ·48	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·48	11½ × 3½ × ·56
26000	9½ × 3½ × ·48	9½ × 3½ × ·50	10 × 3½ × ·50	10½ × 3½ × ·50	11 × 3½ × ·50	11 × 3½ × ·54	11½ × 3½ × ·50	11½ × 3½ × ·56

BULB ANGLES — V

SIDE LONGITUDINALS where ONE TRANSVERSE is FITTED in EACH TANK.

TABLE 10 *(Concluded.)*

SPACING OF TRANSVERSES 12 FEET.

BULB ANGLES OR CHANNELS

FIRST LONGITUDINAL NUMERAL L × D	DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.							
	24	26	28	30	32	34	36	38
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000								
4000								
5000								
6000								
7000								
8000								
9000								
10000								
11000	11 × 3½ × ·50							
12000	11 × 3½ × ·50							
13000	11½ × 3½ × ·44	11½ × 3½ × ·46						
14000	11½ × 3½ × ·44	11½ × 3½ × ·48	11½ × 3½ × ·54					
15000	11½ × 3½ × ·46	11½ × 3½ × ·50	11½ × 3½ × ·56	12 × 3½ × ·50				
16000	11½ × 3½ × ·48	11½ × 3½ × ·52	11½ × 3½ × ·56	12 × 3½ × ·52				
17000	11½ × 3½ × ·50	11½ × 3½ × ·54	11½ × 3½ × ·58	12 × 3½ × ·54	12 × 3½ × ·58			
18000	11½ × 3½ × ·50	11½ × 3½ × ·54	11½ × 3½ × ·60	12 × 3½ × ·54	12 × 3½ × ·60			
19000	11½ × 3½ × ·52	11½ × 3½ × ·56	11½ × 3½ × ·60	12 × 3½ × ·56	12 × 3½ × ·60	12 × 3½ × ·64		
20000	11½ × 3½ × ·54	12 × 3½ × ·48	12 × 3½ × ·54	12 × 3½ × ·56	12 × 3½ × ·60	12 × 3½ × 3½ × ·48		
21000	11½ × 3½ × ·54	12 × 3½ × ·48	12 × 3½ × ·54	12 × 3½ × ·58	12 × 3½ × ·62	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·52	
22000	11½ × 3½ × ·56	12 × 3½ × ·50	12 × 3½ × ·56	12 × 3½ × ·58	12 × 3½ × ·64	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·52	
23000	11½ × 3½ × ·58	12 × 3½ × ·50	12 × 3½ × ·56	12 × 3½ × ·60	12 × 3½ × 3½ × ·48	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·54	
24000	11½ × 3½ × ·58	12 × 3½ × ·52	12 × 3½ × ·58	12 × 3½ × ·62	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·54	12 × 3½ × 3½ × ·56	12 × 3½ × 3½ × ·58
25000	11½ × 3½ × ·60	12 × 3½ × ·54	12 × 3½ × ·58	12 × 3½ × ·62	12 × 3½ × 3½ × ·50	12 × 3½ × 3½ × ·56	12 × 3½ × 3½ × ·58	12 × 3½ × 3½ × ·60
26000	11½ × 3½ × ·60	12 × 3½ × ·54	12 × 3½ × ·60	12 × 3½ × ·66	12 × 3½ × 3½ × ·52	12 × 3½ × 3½ × ·56	12 × 3½ × 3½ × ·60	12 × 3½ × 3½ × ·62

SIDE LONGITUDINALS where MORE than ONE TRANSVERSE is FITTED in EACH TANK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 11

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		IN 'TWEEN DECKS.	DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.						
			10	12	14	16	18	20	22
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000	A	5 × 3 × ·36	6 × 3 × ·38	7 × 3 × ·36					
4000		5 × 3 × ·36	6½ × 3 × ·34	7 × 3 × ·36					
5000		5½ × 3 × ·36	6½ × 3 × ·36	7 × 3 × ·36	7½ × 3 × ·36				
6000		6 × 3 × ·36	6½ × 3 × ·38	7 × 3 × ·38	7½ × 3 × ·38	7½ × 3 × ·40			
7000		6 × 3½ × ·36	6½ × 3½ × ·40	7 × 3½ × ·40	7½ × 3½ × ·40	7½ × 3½ × ·40	8 × 3½ × ·44		
8000		6 × 3½ × ·36	6½ × 3½ × ·42	7 × 3½ × ·42	7½ × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·46	8½ × 3½ × ·42	
9000		6 × 3½ × ·38	6½ × 3½ × ·42	7 × 3½ × ·42	7½ × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·46	8½ × 3½ × ·44	9 × 3½ × ·40
10000		6½ × 3½ × ·38	7 × 3½ × ·38	7½ × 3½ × ·38	7½ × 3½ × ·44	8 × 3½ × ·42	8½ × 3½ × ·40	8½ × 3½ × ·44	9 × 3½ × ·40
11000		6½ × 3½ × ·38	7 × 3½ × ·38	7½ × 3½ × ·38	7½ × 3½ × ·46	8 × 3½ × ·42	8½ × 3½ × ·40	8½ × 3½ × ·46	9 × 3½ × ·42
12000		6½ × 3½ × ·40	7 × 3½ × ·40	7½ × 3½ × ·40	7½ × 3½ × ·46	8 × 3½ × ·44	8½ × 3½ × ·42	8½ × 3½ × ·46	9 × 3½ × ·42
13000		6½ × 3½ × ·40	7 × 3½ × ·40	7½ × 3½ × ·40	8 × 3½ × ·40	8 × 3½ × ·46	8½ × 3½ × ·44	9 × 3½ × ·40	9 × 3½ × ·44
14000		6½ × 3½ × ·42	7 × 3½ × ·42	7½ × 3½ × ·42	8 × 3½ × ·42	8 × 3½ × ·46	8½ × 3½ × ·44	9 × 3½ × ·40	9 × 3½ × ·46
15000		6½ × 3½ × ·42	7 × 3½ × ·42	7½ × 3½ × ·42	8 × 3½ × ·44	8½ × 3½ × ·42	8½ × 3½ × ·46	9 × 3½ × ·42	9 × 3½ × ·48
16000		7 × 3½ × ·40	7 × 3½ × ·44	7½ × 3½ × ·44	8 × 3½ × ·44	8½ × 3½ × ·42	8½ × 3½ × ·46	9 × 3½ × ·42	9 × 3½ × ·48
17000		7 × 3½ × ·40 10.6	7½ × 3½ × ·38 12.05	7½ × 3½ × ·44 12.90	8 × 3½ × ·46 15.05	8½ × 3½ × ·44 16.85	9 × 3½ × ·40 18.50	9 × 3½ × ·44 19.20	9½ × 3½ × ·42 20.85
18000		7 × 3½ × ·42 10.85	7½ × 3½ × ·38 12.05	7½ × 3½ × ·46 13.15	8 × 3½ × ·46 15.05	8½ × 3½ × ·44 17.90	9 × 3½ × ·40 18.50	9 × 3½ × ·44 19.20	9½ × 3½ × ·42 20.85
19000		7 × 3½ × ·42	7½ × 3½ × ·40	8 × 3½ × ·40	8 × 3½ × ·48	8½ × 3½ × ·46	9 × 3½ × ·42	9 × 3½ × ·46	9½ × 3½ × ·44
20000		7 × 3½ × ·44	7½ × 3½ × ·40	8 × 3½ × ·40	8 × 3½ × ·48	8½ × 3½ × ·46	9 × 3½ × ·42	9 × 3½ × ·46	9½ × 3½ × ·44
21000		7 × 3½ × ·44	7½ × 3½ × ·42	8 × 3½ × ·42	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·46
22000		7½ × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·42	8½ × 3½ × ·42	8½ × 3½ × ·48	9 × 3½ × ·44	9 × 3½ × ·50	9½ × 3½ × ·46
23000		7½ × 3½ × ·44	8 × 3½ × ·40	8 × 3½ × ·44	8½ × 3½ × ·44	8½ × 3½ × ·50	9 × 3½ × ·46	9 × 3½ × ·50	9½ × 3½ × ·48
24000		7½ × 3½ × ·44	8 × 3½ × ·42	8 × 3½ × ·46	8½ × 3½ × ·44	8½ × 3½ × ·50	9 × 3½ × ·46	9½ × 3½ × ·44	9½ × 3½ × ·48
25000		8 × 3½ × ·42	8 × 3½ × ·44	8 × 3½ × ·48	8½ × 3½ × ·46	9 × 3½ × ·44	9 × 3½ × ·48	9½ × 3½ × ·44	9½ × 3½ × ·50
26000	V	8 × 3½ × ·44	8 × 3½ × ·46	8 × 3½ × ·48	8½ × 3½ × ·46	9 × 3½ × ·44	9 × 3½ × ·50	9½ × 3½ × ·46	9½ × 3½ × ·50

BULB ANGLES

SIDE LONGITUDINALS where MORE than ONE TRANSVERSE is FITTED in EACH TANK.

SPACING OF TRANSVERSES 8 FEET.

TABLE 11

(See Continuation.)

FIRST LONGITUDINAL NUMERAL L × D		DISTANCE, IN FEET, OF LONGITUDINAL BELOW UPPER DECK AT SIDE.							
		24	26	28	30	32	34	36	38
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3000	∧								
4000									
5000									
6000									
7000									
8000									
9000									
10000									
11000		9 × 3½ × ·48							
12000		9½ × 3½ × ·42							
13000		9½ × 3½ × ·42	9½ × 3½ × ·46						
14000		9½ × 3½ × ·44	9½ × 3½ × ·48	10 × 3½ × ·44					
15000		9½ × 3½ × ·44	9½ × 3½ × ·48	10 × 3½ × ·44	10 × 3½ × ·48				
16000		9½ × 3½ × ·46	9½ × 3½ × ·50	10 × 3½ × ·46	10 × 3½ × ·50				
17000		9½ × 3½ × ·46 21·85	9½ × 3½ × ·50 22·75	10 × 3½ × ·46 24·35	10 × 3½ × ·50 25·35	10½ × 3½ × ·46 27·50			
18000		9½ × 3½ × ·48 22·10	10 × 3½ × ·44 23·85	10 × 3½ × ·48 24·85	10 × 3½ × ·52 25·80	10½ × 3½ × ·46 27·50			
19000		9½ × 3½ × ·48	10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·52	10½ × 3½ × ·48			
20000		9½ × 3½ × ·50	10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·48	10½ × 3½ × ·50		
21000		9½ × 3½ × ·50	10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·52	11 × 3½ × ·44	
22000		10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·52	10 × 3½ × ·56	10½ × 3½ × ·50	10½ × 3½ × ·52	11 × 3½ × ·46	
23000		10 × 3½ × ·44	10 × 3½ × ·48	10 × 3½ × ·52	10 × 3½ × ·56	10½ × 3½ × ·50	10½ × 3½ × ·54	11 × 3½ × ·48	
24000		10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10 × 3½ × ·58	10½ × 3½ × ·52	10½ × 3½ × ·54	11 × 3½ × ·48	11 × 3½ × ·52
25000		10 × 3½ × ·46	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·54	10½ × 3½ × ·56	11 × 3½ × ·50	11 × 3½ × ·54
26000	∨	10 × 3½ × ·48	10 × 3½ × ·50	10 × 3½ × ·54	10½ × 3½ × ·50	10½ × 3½ × ·54	10½ × 3½ × ·56	11 × 3½ × ·50	11 × 3½ × ·54

BULB ANGLES

RIVET ATTACHMENT of STIFFENING BARS of TRANSVERSES to LONGITUDINALS.

TABLE 12

DEPTH AND TYPE OF LONGITUDINALS.	DIMENSIONS OF STIFFENING BAR.					
	3 and $3\frac{1}{2}$ Inch.		5 Inch.		6 Inch.	
	RIVET ATTACHMENT.		RIVET ATTACHMENT.		RIVET ATTACHMENT.	
	No.	Diameter.	No.	Diameter.	No.	Diameter.
		Inch.		Inch.		Inch.
Bulb Angles not exceeding ... ... Inches. $7\frac{1}{2}$	2	$\frac{3}{4}$	3	$\frac{3}{4}$	4	$\frac{3}{4}$
Bulb Angles ... ... 8 to $9\frac{1}{2}$	2	$\frac{3}{4}$	4	$\frac{3}{4}$	4	$\frac{7}{8}$
Bulb Angles ... ... 10 to $11\frac{1}{2}$	2	$\frac{7}{8}$	5	$\frac{3}{4}$	5	$\frac{7}{8}$
Bulb Angles or Channel 12	3	$\frac{7}{8}$	5	$\frac{7}{8}$	6	$\frac{7}{8}$
Channel ... ... 13 and 14	3	$\frac{7}{8}$			6	$\frac{7}{8}$
Channel or Built ... ... 15 to 18	4	$\frac{7}{8}$			8	$\frac{7}{8}$
Built ... ... 19 to 20	5	$\frac{7}{8}$			10	$\frac{7}{8}$

BULKHEAD BRACKETS to BOTTOM and SIDE LONGITUDINALS.

BOTTOM LONGITUDINALS.

TABLE 13

TYPE AND DEPTH OF LONGITUDINAL.		LENGTH OF ARM OF BRACKET.		THICKNESS OF BRACKET.	RIVETS IN ARM TO LONGITUDINAL.		RIVETS IN ARM TO BULKHEAD.	
		To Longitudinal.	To Bulkhead.		Number.	Diameter.	Number.	Diameter.
	Inches.	Inches.	Inches.	Inches.		Inches.		Inches.
Bulb Angle	9	42	42	·40	12	$\frac{7}{8}$	9	$\frac{7}{8}$
,,	10	45	45	·40	13	$\frac{7}{8}$	10	$\frac{7}{8}$
,,	11	48	48	·42	14	$\frac{7}{8}$	11	$\frac{7}{8}$
,,	12	50	50	·42	15	$\frac{7}{8}$	11	$\frac{7}{8}$
Channel	12	52	52	·44	16	$\frac{7}{8}$	12	$\frac{7}{8}$
,,	13	53	53	·44	17	$\frac{7}{8}$	13	$\frac{7}{8}$
,,	14	54	54	·44	18	$\frac{7}{8}$	14	$\frac{7}{8}$
,,	15	55	55	·44	19	$\frac{7}{8}$	14	$\frac{7}{8}$
Built Type	15	48	55	·44	Quadruple Riveted Overlap		14	$\frac{7}{8}$
,,	16	49	57	·44	,,		15	$\frac{7}{8}$
,,	17	50	59	·44	,,		15	$\frac{7}{8}$
,,	18	52	61	·46	,,		16	$\frac{7}{8}$
,,	19	54	63	·46	,,		17	$\frac{7}{8}$
,,	20	56	65	·46	,,		18	$\frac{7}{8}$

SIDE LONGITUDINALS.

TYPE AND DEPTH OF LONGITUDINAL.		LENGTH OF EACH ARM OF BRACKET.	THICKNESS OF BRACKET.	RIVETS IN ARM OF BRACKET.	
				Number.	Diameter.
	Inches.	Inches.	Inches.		Inches.
Bulb Angle	5	21	·40	5	$\frac{7}{8}$
,,	6	25	·40	6	$\frac{7}{8}$
,,	7	28	·40	7	$\frac{7}{8}$
,,	8	32	·40	8	$\frac{7}{8}$
,,	9	35	·42	9	$\frac{7}{8}$
,,	10	38	·42	10	$\frac{7}{8}$
,,	11	41	·44	11	$\frac{7}{8}$
,,	12	44	·44	11	$\frac{7}{8}$
Channel	12	44	·44	12	$\frac{7}{8}$
,,	13	46	·44	13	$\frac{7}{8}$
,,	14	48	·44	14	$\frac{7}{8}$
,,	15	50	·44	14	$\frac{7}{8}$

Where longitudinals of intermediate size are fitted the number of rivets is to be as required for the nearest larger size tabulated.

UPPER DECK LONGITUDINALS. TABLE 14

WHERE MORE THAN ONE TRANSVERSE IS FITTED IN EACH TANK.					WHERE ONE TRANSVERSE ONLY IS FITTED IN EACH TANK.			
FIRST LONGITUDINAL NUMERAL L × D		SPAN IN FEET. 8	9	10	FIRST LONGITUDINAL NUMERAL. L × D		OVERALL SPAN IN FEET. 10	11	12
	∧	Inches.	Inches.	Inches.		∧	Inches.	Inches.	Inches.
4500		$5\frac{1}{2} \times 3 \times .40$	$6 \times 3 \times .40$	$6 \times 3 \times .46$	4500		$6 \times 3 \times .40$	$6\frac{1}{2} \times 3 \times .38$	$6\frac{1}{2} \times 3 \times .44$
6000		$5\frac{1}{2} \times 3 \times .44$	$6 \times 3 \times .42$	$6\frac{1}{2} \times 3 \times .40$	6000		$6 \times 3 \times .42$	$6\frac{1}{2} \times 3 \times .40$	$6\frac{1}{2} \times 3 \times .46$
7550		$6 \times 3 \times .38$	$6 \times 3 \times .44$	$6\frac{1}{2} \times 3 \times .42$	7550		$6 \times 3 \times .44$	$6\frac{1}{2} \times 3 \times .42$	$7 \times 3 \times .40$
9150		$6 \times 3 \times .42$	$6 \times 3 \times .46$	$6\frac{1}{2} \times 3 \times .44$	9150		$6 \times 3 \times .46$	$6\frac{1}{2} \times 3 \times .44$	$7 \times 3 \times .42$
10800		$6 \times 3 \times .44$	$6 \times 3 \times .48$	$6\frac{1}{2} \times 3 \times .46$	10800		$6\frac{1}{2} \times 3 \times .40$	$6\frac{1}{2} \times 3 \times .46$	$7 \times 3 \times .44$
12500		$6\frac{1}{2} \times 3 \times .38$	$6\frac{1}{2} \times 3 \times .42$	$7 \times 3 \times .40$	12500		$6\frac{1}{2} \times 3 \times .42$	$7 \times 3 \times .40$	$7 \times 3 \times .46$
14250		$6\frac{1}{2} \times 3 \times .40$	$6\frac{1}{2} \times 3 \times .44$	$7 \times 3 \times .42$	14250		$6\frac{1}{2} \times 3 \times .44$	$7 \times 3 \times .42$	$7\frac{1}{2} \times 3 \times .40$
16000		$6\frac{1}{2} \times 3 \times .42$	$6\frac{1}{2} \times 3 \times .46$	$7 \times 3 \times .44$	16000		$6\frac{1}{2} \times 3 \times .46$	$7 \times 3 \times .44$	$7\frac{1}{2} \times 3 \times .42$
17800		$6\frac{1}{2} \times 3\frac{1}{2} \times .44$	$6\frac{1}{2} \times 3\frac{1}{2} \times .48$	$7 \times 3\frac{1}{2} \times .46$	17800		$7 \times 3\frac{1}{2} \times .40$	$7 \times 3\frac{1}{2} \times .46$	$7\frac{1}{2} \times 3\frac{1}{2} \times .44$
19650		$6\frac{1}{2} \times 3\frac{1}{2} \times .46$	$7 \times 3\frac{1}{2} \times .42$	$7\frac{1}{2} \times 3\frac{1}{2} \times .40$	19650		$7 \times 3\frac{1}{2} \times .42$	$7\frac{1}{2} \times 3\frac{1}{2} \times .40$	$7\frac{1}{2} \times 3\frac{1}{2} \times .46$
21550		$6\frac{1}{2} \times 3\frac{1}{2} \times .48$	$7 \times 3\frac{1}{2} \times .44$	$7\frac{1}{2} \times 3\frac{1}{2} \times .42$	21550		$7 \times 3\frac{1}{2} \times .44$	$7\frac{1}{2} \times 3\frac{1}{2} \times .42$	$8 \times 3\frac{1}{2} \times .40$
23500		$7 \times 3\frac{1}{2} \times .40$	$7 \times 3\frac{1}{2} \times .46$	$7\frac{1}{2} \times 3\frac{1}{2} \times .44$	23500		$7 \times 3\frac{1}{2} \times .46$	$7\frac{1}{2} \times 3\frac{1}{2} \times .44$	$8 \times 3\frac{1}{2} \times .42$
25500	∨	$7 \times 3\frac{1}{2} \times .42$	$7 \times 3\frac{1}{2} \times .48$	$7\frac{1}{2} \times 3\frac{1}{2} \times .46$	25550	∨	$7 \times 3\frac{1}{2} \times .48$	$7\frac{1}{2} \times 3\frac{1}{2} \times .46$	$8 \times 3\frac{1}{2} \times .44$

BULB ANGLES

LLOYD'S REGISTER OF SHIPPING, LONDON—*5th March*, 1925.

SECOND DECK LONGITUDINALS. TABLE 15

WHERE MORE THAN ONE TRANSVERSE IS FITTED IN EACH TANK.					WHERE ONE TRANSVERSE ONLY IS FITTED IN EACH TANK.				
FIRST LONGITUDINAL NUMERAL L × D	BULB ANGLES	SPAN IN FEET. 8	9	10	FIRST LONGITUDINAL NUMERAL L × D	BULB ANGLES	OVERALL SPAN IN FEET. 10	11	12
	^	Inches.	Inches.	Inches.		^	Inches.	Inches.	Inches.
4500		6 × 3 × ·44	6½ × 3 × ·42	7 × 3 × ·40	4500		6½ × 3 × ·42	7 × 3 × ·40	7½ × 3 × ·38
6000		6 × 3 × ·46	6½ × 3 × ·44	7 × 3 × ·42	6000		6½ × 3 × ·44	7 × 3 × ·42	7½ × 3 × ·40
7550		6½ × 3 × ·40	7 × 3 × ·38	7 × 3 × ·44	7550		6½ × 3 × ·46	7 × 3 × ·44	7½ × 3 × ·42
9150		6½ × 3 × ·42	7 × 3 × ·40	7 × 3 × ·46	9150		7 × 3 × ·40	7 × 3 × ·46	7½ × 3 × ·44
10800		6½ × 3 × ·44	7 × 3 × ·42	7½ × 3 × ·40	10800		7 × 3 × ·42	7½ × 3 × ·40	7½ × 3 × ·46
12500		6½ × 3 × ·46	7 × 3 × ·44	7½ × 3 × ·42	12500		7 × 3 × ·44	7½ × 3 × ·42	8 × 3 × ·40
14250		7 × 3 × ·40	7½ × 3 × ·38	7½ × 3 × ·44	14250		7 × 3 × ·46	7½ × 3 × ·44	8 × 3 × ·42
16000		7 × 3 × ·42	7½ × 3 × ·40	7½ × 3 × ·46	16000		7 × 3 × ·48	7½ × 3 × ·46	8 × 3 × ·44
17800		7 × 3½ × ·44	7½ × 3½ × ·42	8 × 3½ × ·40	17800		7½ × 3½ × ·42	8 × 3½ × ·40	8 × 3½ × ·46
19650		7 × 3½ × ·46	7½ × 3½ × ·44	8 × 3½ × ·42	19650		7½ × 3½ × ·44	8 × 3½ × ·42	8½ × 3½ × ·40
21550		7½ × 3½ × ·42	8 × 3½ × ·38	8 × 3½ × ·44	21550		7½ × 3½ × ·46	8 × 3½ × ·44	8½ × 3½ × ·42
23500		7½ × 3½ × ·44	8 × 3½ × ·40	8 × 3½ × ·46	23500		7½ × 3½ × ·48	8 × 3½ × ·46	8½ × 3½ × ·44
25500	v	7½ × 3½ × ·46	8 × 3½ × ·42	8 × 3½ × ·48	25550	v	8 × 3½ × ·42	8 × 3½ × ·48	8½ × 3½ × ·46

TABLE 16

RIVETS in BRACKETS to DECK LONGITUDINALS.

DEPTH OF LONGITUDINAL.	NUMBER AND DIAMETER OF RIVETS.				LENGTH OF EACH ARM OF BRACKET.	THICKNESS OF BRACKET TO UPPER DECK LONGITUDINALS.	THICKNESS OF BRACKET TO SECOND DECK LONGITUDINALS.
	UPPER DECK.		SECOND DECK.				
Inches.	Number.	Diameter.	Number.	Diameter.	Inches.	Inches.	Inches.
5	5	$\frac{7}{8}$	5	$\frac{7}{8}$	20	·40	·40
$5\frac{1}{2}$	5	$\frac{7}{8}$	6	$\frac{7}{8}$	22	·40	·40
6	6	$\frac{7}{8}$	6	$\frac{7}{8}$	24	·40	·40
$6\frac{1}{2}$	6	$\frac{7}{8}$	7	$\frac{7}{8}$	26	·40	·42
7	7	$\frac{7}{8}$	7	$\frac{7}{8}$	28	·42	·42
$7\frac{1}{2}$	7	$\frac{7}{8}$	8	$\frac{7}{8}$	30	·42	·44
8	7	$\frac{7}{8}$	8	$\frac{7}{8}$	32	·42	·44
$8\frac{1}{2}$	8	$\frac{7}{8}$	9	$\frac{7}{8}$	34	·44	·44
9	8	$\frac{7}{8}$	9	$\frac{7}{8}$	36	·44	·44
$9\frac{1}{2}$	8	$\frac{7}{8}$	9	$\frac{7}{8}$	38	·44	·44

SHELL PLATING. TABLE 17

FIRST LONGITUDINAL NUMERAL L × D	BREADTH OF FLAT PLATE KEEL.	THICKNESS OF FLAT PLATE KEEL.		THICKNESS OF SHELL PLATING.				
				FROM FLAT PLATE KEEL TO UPPER TURN OF BILGE.		FROM UPPER TURN OF BILGE TO STRAKE BELOW SHEERSTRAKE.		PROPELLER BOSS PLATES.
		For ⅔-Length Amidships.	At Ends.	For ½-Length Amidships.	At Ends.	For ½-Length Amidships.	At Ends.	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
4800	43	·66	·52	·46	·38	·44	·38	·48
5900	44	·70	·54	·48	·40	·46	·40	·52
7000	45	·74	·58	·50	·42	·48	·40	·56
8200	47	·78	·60	·52	·42	·50	·42	·60
9400	48	·82	·62	·54	·44	·52	·42	·62
10600	49	·84	·64	·56	·46	·54	·44	·66
11800	50	·88	·68	·58	·46	·56	·44	·70
13000	51	·92	·70	·60	·48	·58	·46	·72
14200	52	·94	·74	·62	·50	·60	·46	·74
15400	53	·98	·78	·64	·50	·62	·48	·78
16700	54	1·02	·80	·66	·52	·64	·48	·80
18000	55	1·06	·82	·68	·52	·66	·50	·82
19300	56	1·10	·84	·72	·54	·66	·50	·84
20600	57	1·14	·88	·74	·56	·68	·52	·86
22000	59	1·18	·90	·76	·56	·70	·52	·88
23500	60	1·22	·94	·80	·58	·72	·54	·90
25000	61	1·26	·98	·82	·60	·74	·56	·92
26500	62	1·30	1·00	·84	·62	·76	·56	·94
28000	63	1·34	1·04	·86	·62	·76	·58	·96

TOPSIDE SCANTLINGS.

TABLE 18

(See Continuation.)

SECOND LONGITUDINAL NUMERAL L × (B + D)	BREADTH OF.		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.							
			11				12			
	Sheerstrake and Strake below.	Stringer Plate.	THICKNESS OF UPPER DECK, SHEERSTRAKE AND STRAKE BELOW.							
			Sheerstrake.	Strake Below.	Stringer Plate.	Deck Plating.	Sheerstrake.	Strake Below.	Stringer Plate.	Deck Plating.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
15000	47	45	·50	·46	·48	·34	·52	·48	·50	·34
16000	47	45	·52	·48	·48	·34	·54	·50	·50	·34
17000	47	45	·52	·48	·48	·34	·54	·50	·50	·34
18000	48	45	·54	·50	·48	·34	·56	·52	·50	·34
19000	48	46	·54	·50	·48	·34	·56	·52	·50	·34
20000	48	46	·54	·50	·50	·36	·56	·54	·50	·36
21000	48	47	·56	·52	·50	·36	·58	·56	·52	·36
22000	48	48	·56	·52	·50	·36	·58	·56	·52	·36
23000	49	49	·58	·54	·50	·36	·60	·58	·52	·36
24000	49	50	·58	·56	·50	·38	·62	·58	·54	·38
25500	49	51	·60	·58	·50	·38	·64	·60	·54	·38
27000	49	52	·62	·60	·50	·38	·66	·62	·54	·38
28500	50	53	·64	·60	·50	·40	·68	·62	·54	·40
30000	50	54	·64	·62	·52	·40	·68	·64	·56	·42
31500	50	55	·66	·64	·52	·40	·70	·66	·56	·42
33000	50	56	·66	·64	·52	·40	·72	·66	·56	·44
34500	50	57	·68	·66	·54	·42	·74	·68	·58	·46
36000	50	58	·70	·66	·54	·42	·76	·70	·58	·48
37500	51	59	·70	·66	·56	·44	·76	·70	·60	·50
39000	51	60	·72	·68	·56	·46	·78	·72	·60	·50
40500	51	61	·74	·70	·58	·48	·80	·74	·62	·52
42000	51	62	·74	·70	·58	·48	·82	·74	·64	·54
43500	51	63	·76	·72	·60	·50	·84	·76	·64	·54
45000	52	64	·78	·74	·60	·50	·86	·78	·66	·56
46500	52	65	·78	·74	·62	·52	·86	·78	·66	·58
48000	52	66	·80	·76	·62	·54	·88	·80	·68	·60
50000	52	68	·80	·78	·64	·56	·88	·82	·68	·62
52000	53	69	·82	·78	·66	·58	·90	·82	·70	·64
54000	53	70	·84	·80	·66	·60	·92	·84	·72	·66
56000	53	72	·86	·82	68	·64	·94	·86	·74	·68
58000	54	74	·86	·82	·70	·66	·94	·86	·76	·70
60000	54	76	·88	·84	·72	·66	·96	·88	·78	·72
62000	54	77	·88	·84	·76	·68	·96	·88	·82	·74
64000	55	79	·90	·86	·78	·70	·98	·90	·84	·76
66000	55	80	·92	·88	·80	·74	1·00	·92	·88	·80

TOPSIDE SCANTLINGS.

TABLE 18 *(Concluded.)*

SECOND LONGITUDINAL NUMERAL $L \times (B + D)$	BREADTH OF.		PROPORTION OF LENGTH OF VESSEL TO DEPTH TO UPPER DECK.								THICKNESSES AT ENDS.	
			13				$13\frac{1}{2}$					
			THICKNESS OF UPPER DECK, SHEERSTRAKE AND STRAKE BELOW.									
	Sheer-strake and Strake Below.	Stringer Plate.	Sheer-strake.	Strake Below.	Stringer Plate.	Deck Plating.	Sheer-strake.	Strake Below.	Stringer Plate.	Deck Plating.	Stringer Plate.	Deck Plating.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
15000	47	45	·58	·50	·50	·34	·60	·52	·52	·34	·36	·30
16000	47	45	·60	·52	·50	·34	·62	·54	·52	·34	·36	·30
17000	47	45	·60	·54	·52	·34	·64	·56	·54	·36	·36	·30
18000	48	45	·62	·54	·52	·36	·66	·56	·54	·38	·36	·30
19000	48	46	·64	·56	·54	·36	·66	·58	·56	·38	·38	·30
20000	48	46	·64	·56	·54	·36	·68	·58	·56	·38	·38	·30
21000	48	47	·66	·58	·56	·38	·70	·60	·58	·40	·38	·30
22000	48	48	·68	·60	·56	·38	·72	·62	·58	·40	·38	·30
23000	49	49	·70	·62	·56	·38	·74	·64	·58	·40	·38	·30
24000	49	50	·72	·64	·58	·38	·76	·66	·60	·40	·38	·32
25500	49	51	·74	·64	·58	·40	·78	·66	·60	·42	·40	·32
27000	49	52	·76	·66	·58	·40	·80	·68	·60	·42	·40	·32
28500	50	53	·78	·68	·58	·42	·82	·70	·62	·44	·40	·32
30000	50	54	·80	·70	·60	·44	·84	·72	·62	·46	·40	·34
31500	50	55	·82	·72	·62	·46	·86	·74	·64	·48	·42	·34
33000	50	56	·84	·72	·62	·48	·88	·74	·64	·50	·42	·34
34500	50	57	·86	·74	·64	·50	·90	·76	·66	·50	·42	·34
36000	50	58	·88	·76	·64	·50	·92	·78	·66	·52	·42	·36
37500	51	59	·88	·78	·66	·52	·94	·80	·66	·54	·44	·36
39000	51	60	·90	·80	·66	·54	·96	·82	·68	·56	·44	·36
40500	51	61	·92	·80	·66	·56	·96	·82	·68	·58	·44	·36
42000	51	62	·94	·82	·68	·58	·98	·84	·70	·60	·44	·36
43500	51	63	·96	·82	·68	·60	1·00	·86	·70	·62	·44	·36
45000	52	64	·98	·84	·70	·62	1·02	·88	·72	·64	·44	·36
46500	52	65	·98	·86	·72	·64	1·04	·90	·74	·66	·44	·36
48000	52	66	1·00	·88	·72	·66	1·06	·90	·76	·66	·44	·36
50000	52	68	1·02	·90	·74	·66	1·08	·92	·78	·68	·46	·36
52000	53	69	1·04	·90	·76	·68	1·10	·92	·80	·70	·46	·38
54000	53	70	1·06	·92	·78	·70	1·12	·94	·82	·74	·46	·38
56000	53	72	1·08	·94	·80	·74	1·14	·96	·84	·78	·46	·38
58000	54	74	1·10	·94	·84	·76	1·16	·98	·88	·80	·46	·38
60000	54	76	1·12	·96	·86	·78	1·18	1·00	·90	·82	·46	·38
62000	54	77	1·12	·98	·88	·82	1·20	1·02	·92	·86	·46	·38
64000	55	78	1·14	1·00	·90	·84	1·22	1·04	·94	·88	·48	·38
66000	55	80	1·16	1·02	·92	·86	1·24	1·08	·96	·92	·48	·38

SECOND DECK PLATING. TABLE 19

L × (B + D)	BREADTH OF STRINGER PLATE.	THICKNESS.		STRINGER ANGLE.
		Stringer Plate.	Plating.	
	Inches.	Inches.	Inches.	Inches.
13800	42	·36	·34	5 × 5 × ·40
17700	43	·36	·34	6 × 6 × ·40
22100	44	·38	·36	6 × 6 × ·42
27000	45	·40	·38	6 × 6 × ·42
32400	47	·42	·40	6 × 6 × ·44
38300	48	·44	·42	6 × 6 × ·44
44600	50	·46	·44	6 × 6 × ·46
51000	51	·46	·46	6 × 6 × ·48
57400	53	·48	·48	6 × 6 × ·48
63800	54	·50	·50	6 × 6 × ·50

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TABLE 20

STRINGER ANGLES on UPPER DECK in WAY of OIL TANKS.

THICKNESS OF SHEERSTRAKE.			SIZE OF FLANGES.
Inches. Above —	and	not exceeding ·96	Inches. 6 × 6
·96	„	1·14	7 × 7
1·14	„	1·20	8 × 8
The thickness of the Bars is to be the same as that of the Stringer Plate.			

TABLE 21

KEEL ANGLES.

FIRST LONGITUDINAL NUMERAL L × D	ANGLES CONNECTING CENTRE LINE BULKHEAD TO KEEL PLATE.	
	FOR ½ LENGTH AMIDSHIPS.	THICKNESS AT ENDS.
5000	Inches. 4 × 4 × ·48	Inches. ·46
6000	4 × 4 × ·50	·48
7500	4 × 4 × ·52	·48
9500	4 × 4 × ·54	·50
12000	4 × 4 × ·56	·50
15000	4 × 4 × ·58	·52
18500	4 × 4 × ·60	·54
22500	4 × 4 × ·62	·56
27000	4 × 4 × ·64	·58

BULKHEAD PLATING. TABLE 22

DEPTH BELOW TOP OF BULKHEAD.	THICKNESS OF PLATING.	DEPTH BELOW TOP OF BULKHEAD.	THICKNESS OF PLATING.
Feet.	Inches.	Feet.	Inches.
6	·34	26	·42
10	·34	30	·44
14	·36	34	·46
18	·38	38	·48
22	·40	42	·50

Bottom Strake to be increased ·04.

TABLE 23

BULKHEAD BOUNDARY BARS.

DEPTH OF BULKHEAD.	ANGLES ATTACHING TRANSVERSE BULKHEADS TO SHELL PLATING, CENTRE LINE BULKHEAD, SECOND DECK, AND SIDES AND TOP OF EXPANSION TRUNK AND CENTRE LINE BULKHEAD TO DECK.	
	Double.	Single.
Feet.	Inches.	Inches.
18	3 × 3 × ·34	6 × 6 × ·42
22	3 × 3 × ·36	6 × 6 × ·44
26	3 × 3 × ·38	6 × 6 × ·46
30	3½ × 3½ × ·38	6 × 6 × ·48
34	3½ × 3½ × ·40	6 × 6 × ·50
38	3½ × 3½ × ·42	6 × 6 × ·52
42	3½ × 3½ × ·44	6 × 6 × ·54

TRANSVERSE BULKHEADS.

VERTICAL WEBS BELOW SECOND DECK.

TABLE 24

DEPTH FROM SECOND DECK TO INNER EDGE OF BOTTOM LONGITUDINALS.	PLATE AND FACE BAR.	SPACING OF WEBS.					
		Feet. Inches. 7 — 6		Feet. Inches. 8 — 6		Feet. Inches. 9 — 6	
		DEPTH FROM UPPER DECK AT CENTRE TO TOP OF WEB.					
		Feet. 8	Feet. 10	Feet. 8	Feet. 10	Feet. 8	Feet. 10
Feet. 10	Web Face Angle	Inches. 16 × ·36 3 × 3 × ·28	Inches.	Inches. 17 × ·36 3 × 3 × ·30	Inches.	Inches. 18 × ·36 3 × 3 × ·32	Inches.
12	Web Face Angle	19 × ·38 3 × 3 × ·32		20 × ·38 3 × 3 × ·34		21 × ·38 3 × 3 × ·36	
14	Web Face Angle	22 × ·40 3 × 3 × ·36	23 × ·40 3 × 3 × ·36	22 × ·40 3 × 3 × ·38	23 × ·40 3 × 3 × ·42	23 × ·40 3 × 3 × ·42	24 × ·40 4 × 3 × ·38
16	Web Face Angle	24 × ·40 3½ × 3 × ·36	25 × ·40 3½ × 3 × ·40	25 × ·40 3½ × 3 × ·44	26 × ·40 3½ × 3 × ·44	26 × ·40 4 × 3 × ·40	27 × ·40 4½ × 3 × ·42
18	Web Face Angle	26 × ·40 4 × 3 × ·44	27 × ·40 4 × 3 × ·50	27 × ·40 4½ × 3 × ·50	28 × ·40 5 × 3 × ·50	28 × ·40 5½ × 3 × ·50	29 × ·40 6 × 3½ × ·48
20	Web Face Angle	29 × ·40 5½ × 3 × ·46	30 × ·40 5½ × 3½ × ·48	30 × ·40 5½ × 3½ × ·50	31 × ·40 6 × 3½ × ·50	31 × ·40 6½ × 3½ × ·50	32 × ·40 6½ × 3½ × ·56
22	Web Face Angle	31 × ·40 6½ × 3½ × ·50	32 × ·40 6½ × 3½ × ·56	32 × ·40 7 × 3½ × ·56	33 × ·42 4 × 3½ × ·42	33 × ·42 4 × 3½ × ·44	34 × ·42 4½ × 3½ × ·46
24	Web Double Face Angles	33 × ·42 3½ × 3½ × ·46	34 × ·42 4 × 3½ × ·48	35 × ·42 4 × 3½ × ·48	36 × ·42 4 × 3½ × ·50	36 × ·42 4½ × 3½ × ·48	37 × ·42 5 × 3½ × ·50
26	Web Double Face Angles	35 × ·42 5 × 3½ × ·46	36 × ·42 5 × 3½ × ·50	37 × ·42 5 × 3½ × ·52	38 × ·44 5½ × 3½ × ·50	38 × ·44 6 × 3½ × ·50	39 × ·44 6½ × 3½ × ·52
28	Web Double Face Angles	37 × ·42 6 × 3½ × ·50	38 × ·44 6½ × 3½ × ·50	39 × ·44 6½ × 3½ × ·52	40 × ·44 7 × 3½ × ·52	40 × ·44 7 × 3½ × ·56	41 × ·44 7 × 3½ × ·54
30	Web Double Face Angles	39 × ·44 7 × 3½ × ·52	40 × ·44 7 × 3½ × ·50	41 × ·44 7 × 3½ × ·54	42 × ·46 8 × 3½ × ·50	42 × ·46 8 × 3½ × ·52	43 × ·46 8 × 3½ × ·58
32	Web Double Face Bulb Angles	41 × ·44 7½ × 3½ × ·52	42 × ·46 8 × 3½ × ·54	43 × ·46 8 × 3½ × ·56	44 × ·46 8 × 3½ × ·58	45 × ·46 8½ × 3½ × ·56	46 × ·46 9 × 3½ × ·58
34	Web Double Face Bulb Angles	44 × ·46 8 × 3½ × ·56	45 × ·46 8½ × 3½ × ·58	46 × ·46 8½ × 3½ × ·60	47 × ·46 9 × 3½ × ·62	48 × ·46 9 × 3½ × ·62	49 × ·48 9½ × 3½ × ·62
36	Web Double Face Bulb Angles	47 × ·46 8½ × 3½ × ·60		50 × ·48 9 × 3½ × ·60		51 × ·48 10 × 3½ × ·62	

TABLE 25

TRANSVERSE BULKHEADS.

VERTICAL WEBS IN EXPANSION TRUNK.

BREADTH OF SHIP. B	PLATE AND FLANGE.	HEIGHT OF TWEEN DECKS IN FEET.	
		8	10
Feet.		Inches.	Inches.
30	Web	16 × ·36	17 × ·38
	Flange	5	5
40	Web	17 × ·38	18 × ·40
	Flange	5	5
50	Web	18 × ·40	19 × ·42
	Flange	5	5
60	Web	18 × ·42	20 × ·42
	Flange	5	5
70	Web	19 × ·42	21 × ·42
	Flange	5	5

LLOYD'S REGISTER OF SHIPPING, LONDON—*5th March*, 1925.

HORIZONTAL STIFFENERS on TRANSVERSE BULKHEADS. TABLE 26

DEPTH BELOW UPPER DECK AT CENTRE.	SPAN BETWEEN ADJACENT VERTICAL WEBS.			DEPTH BELOW UPPER DECK AT CENTRE.	SPAN BETWEEN VERTICAL WEB AND SHIP'S SIDE OR BETWEEN VERTICAL WEB AND CENTRE LINE BULKHEAD.		
	Feet. Inches. 7 — 6	Feet. Inches. 8 — 6	Feet. Inches. 9 — 6		Feet. Inches. 9 — 0	Feet. Inches. 10 — 0	Feet. Inches. 11 — 0
Feet. 4	Inches. 6 ×3 ×·36	Inches. 6 ×3 ×·38	Inches. 6½×3 ×·34	Feet. 4	Inches. 6 ×3 ×·34	Inches. 6 ×3 ×·36	Inches. 6½×3 ×·40
6	6 ×3 ×·38	6 ×3 ×·40	6½×3 ×·46	6	6 ×3 ×·36	6 ×3 ×·46	7 ×3 ×·36
8	6 ×3 ×·40	6½×3 ×·40	7 ×3 ×·44	8	6 ×3 ×·40	6½×3 ×·46	7 ×3 ×·48
10	6 ×3 ×·42	7 ×3 ×·34	7½×3 ×·42	10	6½×3 ×·36	7 ×3 ×·38	7½×3 ×·42
12	6½×3 ×·38	7½×3 ×·36	8 ×3 ×·40	12	7 ×3 ×·34	7½×3 ×·36	8 ×3 ×·38
14	7 ×3 ×·38	7½×3 ×·46	8½×3 ×·42	14	7 ×3 ×·42	7½×3 ×·46	8½×3 ×·38
16	7½×3 ×·36	8 ×3 ×·46	9 ×3 ×·44	16	7½×3 ×·36	8 ×3 ×·42	8½×3 ×·50
18	7½×3 ×·46	8½×3 ×·46	9½×3½×·44	18	7½×3 ×·48	8½×3 ×·38	9 ×3 ×·46
20	8 ×3 ×·44	9 ×3 ×·44	10 ×3½×·46	20	8 ×3 ×·40	8½×3 ×·50	9½×3½×·46
22	8½×3 ×·40	9½×3½×·44	10 ×3½×·52	22	8 ×3 ×·48	9 ×3 ×·44	9½×3½×·52
24	8½×3 ×·50	9½×3½×·50	10½×3½×·50	24	8½×3 ×·40	9½×3½×·46	10 ×3½×·46
26	9 ×3 ×·44	10 ×3½×·46	11 ×3½×·48	26	8½×3 ×·50	9½×3½×·48	10 ×3½×·54
28	9½×3½×·44	10½×3½×·46	11 ×3½×·56	28	9 ×3 ×·44	9½×3½×·52	10½×3½×·46
30	9½×3½×·46	10½×3½×·48	11½×3½×·52	30	9 ×3 ×·46	10 ×3½×·46	10½×3½×·54
32	10 ×3½×·46	11 ×3½×·48	12 ×3½×·50	32	9½×3½×·44	10 ×3½×·50	11 ×3½×·48
34	10½×3½×·48	11 ×3½×·52	12 ×3½×·58	34	9½×3½×·46	10½×3½×·48	11 ×3½×·54
36	10½×3½×·54	11½×3½×·50	12 ×3½×·66	36	9½×3½×·50	10½×3½×·50	11½×3½×·50

BULB ANGLES

STIFFENERS to TRANSVERSE BULKHEADS in SUMMER TANKS.

VERTICAL STIFFENERS. TABLE 27

HEIGHT OF 'TWEEN DECKS.	SIZE OF STIFFENER.	RIVETS IN BRACKETS AT SECOND DECK.	
		Number.	Diameter.
Feet.	Inches. Bulb Angles.		Inches.
8	6 × 3 × ·36	4	$\frac{7}{8}$
10	$6\frac{1}{2}$ × 3 × ·36	5	$\frac{7}{8}$

HORIZONTAL STIFFENERS.

OVERALL SPAN.	DISTANCE BELOW DECK IN FEET.		
	2·5	5·0	7·5
Feet.	Inches. Bulb Angles.	Inches. Bulb Angles.	Inches. Bulb Angles.
10	6 × 3 × ·36	$6\frac{1}{2}$ × 3 × ·38	7 × 3 × ·40
12	$6\frac{1}{2}$ × 3 × ·38	7 × 3 × ·40	$7\frac{1}{2}$ × 3 × ·42
14	7 × 3 × ·40	$7\frac{1}{2}$ × 3 × ·40	9 × 3 × ·40
16	$7\frac{1}{2}$ × 3 × ·40	$8\frac{1}{2}$ × 3 × ·40	10 × $3\frac{1}{2}$ × ·44
18	8 × 3 × ·40	9 × 3 × ·44	11 × $3\frac{1}{2}$ × ·50

WEBS in 'TWEEN DECKS at CENTRE LINE BULKHEAD and EXPANSION TRUNK. TABLE 28

DEPTH OF 'TWEEN DECK AT CENTRE.	WEB.	SPACING IN FEET.					
		7	8	9	10	11	12
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
8	Breadth	16—22	18—24	20—26	22—28	23—29	24—30
	Thickness	·38	·40	·40	·40	·40	·40
	Flange on Edge	5	5	5	5	5	5
9	Breadth	18—24	20—26	22—28	23—29	24—30	25—31
	Thickness	·40	·40	·40	·40	·40	·40
	Flange on Edge	5	5	5	5	5	5
10	Breadth		22—28	23—29	24—30	25—31	
	Thickness		·40	·40	·40	·40	
	Flange on Edge		5	5	5	5	

HORIZONTAL STIFFENERS to CENTRE LINE BULKHEAD. TABLE 29

WHERE MORE THAN ONE TRANSVERSE IS FITTED IN EACH TANK.					WHERE ONE TRANSVERSE ONLY IS FITTED IN EACH TANK.				
DEPTH BELOW UPPER DECK AT CENTRE.		SPAN IN FEET.			DEPTH BELOW UPPER DECK AT CENTRE.		SPAN IN FEET.		
		8	9	10			10	11	12
Feet.		Inches.	Inches.	Inches.	Feet.		Inches.	Inches.	Inches.
2		6 ×3 ×·34	6½×3 ×·38	7 ×3 ×·40	2		6½×3 ×·38	7 ×3 ×·40	7½×3 ×·40
4		6 ×3 ×·34	6½×3 ×·38	7 ×3 ×·40	4		6½×3 ×·38	7 ×3 ×·40	7½×3 ×·40
6		6 ×3 ×·34	6½×3 ×·38	7 ×3 ×·40	6		6½×3 ×·38	7 ×3 ×·40	7½×3 ×·40
8		6 ×3 ×·38	7 ×3 ×·38	7½×3 ×·40	8		7 ×3 ×·38	7½×3 ×·40	8 ×3 ×·40
10		6½×3 ×·38	7 ×3 ×·44	7½×3 ×·50	10		7 ×3 ×·42	7½×3 ×·46	8 ×3 ×·46
12		6½×3 ×·42	7 ×3 ×·50	8 ×3 ×·44	12		7 ×3 ×·48	8 ×3 ×·42	8½×3 ×·46
14		7 ×3 ×·42	7½×3 ×·50	8½×3 ×·44	14		7½×3 ×·46	8 ×3 ×·52	9 ×3 ×·46
16		7½×3 ×·40	8 ×3 ×·38	9 ×3 ×·44	16		8 ×3 ×·44	8½×3 ×·52	9½×3½×·48
18		7½×3 ×·48	8½×3 ×·44	9 ×3½×·52	18		8 ×3 ×·50	9 ×3 ×·48	9½×3½×·56
20		8 ×3 ×·42	8½×3 ×·50	9½×3½×·48	20		8½×3 ×·46	9 ×3 ×·56	10 ×3½×·52
22		8 ×3 ×·48	9 ×3 ×·46	9½×3½×·56	22		9 ×3 ×·44	9½×3½×·52	10 ×3½×·60
24		8½×3 ×·44	9½×3½×·46	10 ×3½×·54	24		9 ×3½×·50	10 ×3½×·50	10½×3½×·58
26		8½×3 ×·50	9½×3½×·50	10 ×3½×·58	26		9½×3½×·46	10 ×3½×·54	11 ×3½×·52
28		9 ×3 ×·42	9½×3½×·54	10½×3½×·52	28		9½×3½×·50	10 ×3½×·60	11 ×3½×·58
30		9 ×3 ×·46	10 ×3½×·50	10½×3½×·58	30		9½×3½×·54	10½×3½×·54	11½×3½×·52
32		9½×3½×·44	10 ×3½×·54	11 ×3½×·54	32		10 ×3½×·50	10½×3½×·60	11½×3½×·60
34		9½×3½×·48	10 ×3½×·58	11 ×3½×·58	34		10 ×3½×·54	11 ×3½×·54	12 ×3½×·52
36		9½×3½×·52	10 ×3½×·60	11 ×3½×·62	36		10 ×3½×·56	11 ×3½×·58	12 ×3½×·56
38		9½×3½×·56	10½×3½×·54	11½×3½×·56	38		10 ×3½×·60	11 ×3½×·62	12 ×3½×·66
40		9½×3½×·58	10½×3½×·60	12 ×3½×·52	40		10½×3½×·54	11½×3½×·56	12×3½×3½×·54
42		10 ×3½×·52	11 ×3½×·54	12 ×3½×·58	42		10½×3½×·58	11½×3½×·62	12×3½×3½×·58
44		10 ×3½×·56	11 ×3½×·60	12 ×3½×·66	44		11 ×3½×·54	12 ×3½×·58	12×4 ×4 ×·54
46		10 ×3½×·62	11½×3½×·52	12×3½×3½×·52	46		11 ×3½×·60	12 ×3½×·64	12×4 ×4 ×·60

BULB ANGLES

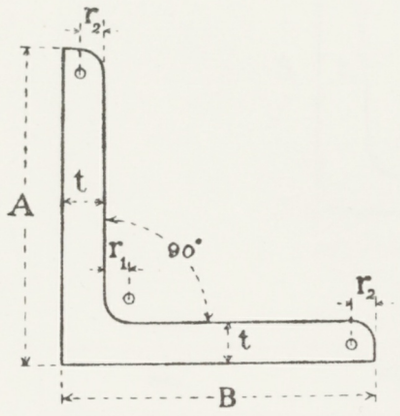
RIVETING of END LAPS. TABLE 30

		Not exceeding ·36	Above ·36 and not exceeding ·38	Above ·38 and not exceeding ·42	Above ·42 and not exceeding ·48	Above ·48 and not exceeding ·54	Above ·54 and not exceeding ·60	Above ·60 and not exceeding ·68	Above ·68 and not exceeding ·76	Above ·76 and not exceeding ·84	Above ·84 and not exceeding ·94	Above ·94 and not exceeding 1·04	Above 1·04 and not exceeding 1·26
KEEL	⅛ L. Amids. ..					Treble	Treble	Quadruple	Quadruple	Quadruple	Double Straps Treble Riveted	Double Straps Treble Riveted	Double Straps Treble Riveted
	Ends					Treble	Treble	Treble	Treble	Quadruple	Quadruple		
BOTTOM SHELL	⅛ L. Amids. ..			Treble	Treble	Treble	Quadruple	Quadruple	Double Straps Treble Riveted	Double Straps Treble Riveted			
	Ends		Double	Double	Treble	Treble	Treble						
SIDE SHELL	⅛ L. Amids. ..			Double	Treble	Treble	Treble	Quadruple	Quadruple				
	Ends		Double	Double	Treble	Treble	Treble						
STRAKE BELOW SHEERSTRAKE	⅛ L. Amids. ..			Treble	Treble	Treble	Treble	Quadruple	Quadruple	Quadruple	Double Straps Treble Riveted	Double Straps Treble Riveted	
	Ends			Double	Treble	Treble	Treble						
SHEERSTRAKE	⅛ L. Amids. ..			Treble	Treble	Treble	Treble	Quadruple	Quadruple	Quadruple	Double Straps Treble Riveted	Double Straps Treble Riveted	Double Straps Treble Riveted
	Ends			Double	Treble	Treble	Treble						
UPPER DECK STRINGER	⅛ L. Amids...			Treble	Treble	Treble	Treble	Quadruple	Quadruple	Quadruple	Double Straps Treble Riveted	Double Straps Treble Riveted	
	Ends			Double	Treble	Treble	Treble	Treble					
UPPER DECK PLATING	⅛ L. Amids...	Double	Double	Double	Double	Treble	Treble	Treble	Quadruple	Quadruple	Quadruple		
SECOND DECK PLATING	⅛ L. Amids...	Double	Double	Double	Double	Treble							
SECOND DECK STRINGER	⅛ L. Amids...	Double	Double	Double	Treble	Treble							

BRITISH STANDARD SECTIONS.

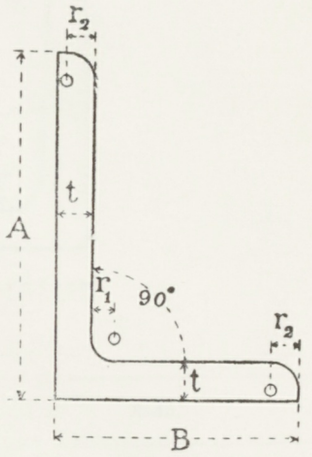
LONDON.—*Revised July, 1920.*

EQUAL ANGLES.



Size.	Thickness at Correct Standard Profile.			Minimum thickness rolled.	Maximum thickness rolled.	Radii.	
A × B	Minimum.	Mean.	Maximum.			Root.	Toe.
	t	t	t			r_1	r_2
Inches.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
¾ × ¾	·125	—	·250	·125	·250	·17	·12
1 × 1	·125	—	·250	·125	·300	·18	·13
1¼ × 1¼	·125	—	·250	·125	·300	·20	·14
1½ × 1½	·125	—	·250	·125	·350	·21	·15
1¾ × 1¾	·175	—	·300	·175	·375	·23	·16
2 × 2	·175	—	·300	·175	·400	·24	·17
2¼ × 2¼	·175	—	·300	·175	·450	·26	·18
2½ × 2½	·250	·375	·500	·200	·500	·27	·19
2¾ × 2¾	·250	·375	·500	·225	·525	·29	·20
3 × 3	·250	·375	·500	·250	·525	·30	·21
3½ × 3½	·300	·425	·500	·275	·575	·33	·23
4 × 4	·300	·425	·500	·300	·625	·36	·25
5 × 5	·375	—	·500	·350	·700	·42	·29
6 × 6	·450	—	·625	·425	·775	·48	·34
8 × 8	·550	—	·750	·550	·950	·60	·42
9 × 9	·550	—	·750	·550	1·000	·66	·46

UNEQUAL ANGLES.

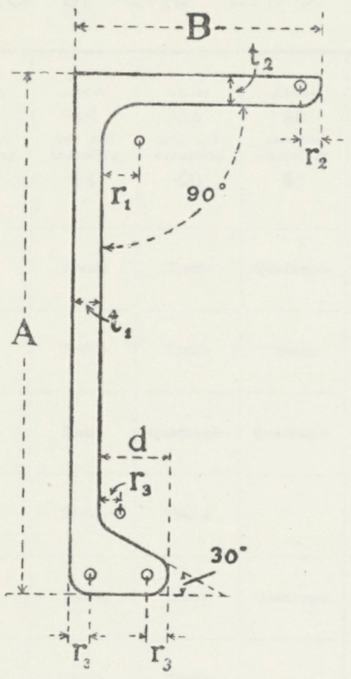


Size.	Thickness at Correct Standard Profile.			Minimum thickness rolled.	Maximum thickness rolled.	Radii	
A × B	Minimum.	Mean.	Maximum.			Root.	Toe.
	t	t	t			r_1	r_2
Inches.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
2 × 1½	·175	—	·300	·150	·375	·23	·16
2½ × 1½	·175	—	·300	·150	·400	·24	·17
2½ × 2	·175	—	·300	·175	·450	·26	·18
3 × 2	·250	·375	·500	·200	·500	·27	·19
3 × 2½	·250	·375	·500	·225	·525	·29	·20
3½ × 2½	·250	·375	·500	·250	·525	·30	·21
3½ × 3	·250	·375	·500	·250	·550	·32	·22
4 × 3	·300	·425	·500	·275	·575	·33	·23
4 × 3½	·300	·425	·500	·275	·600	·35	·24
5 × 3	·300	·425	·500	·300	·625	·36	·25
5 × 3½	·375	—	·500	·325	·625	·38	·26
5 × 4	·375	—	·500	·325	·650	·39	·27
6 × 3	·375	—	·500	·325	·650	·39	·27
6 × 3½	·375	—	·500	·350	·675	·41	·29
6 × 4	·375	—	·500	·350	·700	·42	·29
7 × 3½	—	·525	—	·375	·725	·44	·31
8 × 4	—	·625	—	·425	·775	·48	·34
8 × 6	—	·625	—	·450	·800	·54	·38
9 × 4	—	·650	—	·450	·825	·51	·36
10 × 4	—	·675	—	·475	·850	·54	·38

BRITISH STANDARD SECTIONS.

LONDON.—*Revised July, 1920.*

BULB ANGLES.



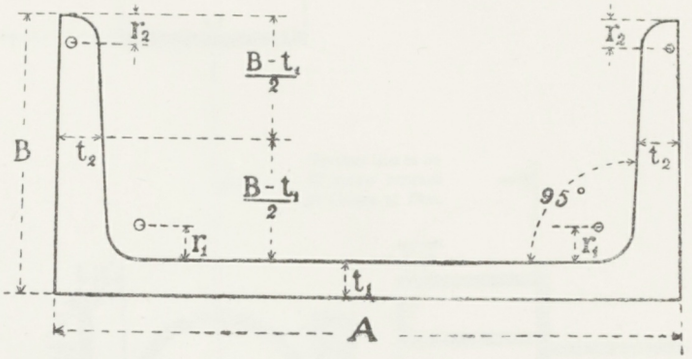
Size. A × B	Thickness at Correct Standard Profile. Web. t_1	Thickness at Correct Standard Profile. Flange. t_2	Web thickness. Minimum rolled.	Web thickness. Maximum rolled.	Radii. r_1	Radii. r_2	Radii. r_3	d
Inches.	Inch.		Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
4 × 2½	·26		·21	·46	·42	·21	·16	·52
4½ × 2½	·28		·23	·48	·42	·21	·18	·58
5 × 2½	·30		·25	·50	·42	·21	·20	·65
5 × 3	·30		·25	·50	·48	·24	·20	·65
5½ × 3	·31		·26	·52	·48	·24	·22	·71
6 × 3	·33		·28	·54	·48	·24	·24	·78
6 × 3½	·33		·28	·54	·54	·27	·24	·78
7 × 3	·38		·33	·59	·48	·24	·28	·91
7 × 3½	·38		·33	·59	·54	·27	·28	·91
8 × 3	·40		·35	·61	·48	·24	·32	1·04
8 × 3½	·40		·35	·61	·54	·27	·32	1·04
9 × 3½	·43		·38	·65	·54	·27	·36	1·17
10 × 3½	·45		·40	·67	·54	·27	·40	1·30
11 × 3½	·48		·43	·70	·54	·27	·44	1·43
12 × 3½	·50		·45	·73	·54	·27	·48	1·56
12 × 4	·50		·45	·73	·60	·30	·48	1·56
13½ × 4	·54		·49	·77	·60	·30	·54	1·75
15 × 4	·57		·52	·82	·60	·30	·60	1·95

Where the thickness of Bulb Angle is greater than the Standard thickness, the flange and web will not be of the same thickness; generally for each ·05 inch increase in the thickness of the web the thickness of the flange will be increased ·025 inch.

BRITISH STANDARD SECTIONS.

LONDON.—*Revised July, 1920.*

CHANNELS.



Size.	Thickness at Correct Standard Profile.		Web thickness.	Radii.	
Web and Flanges.	Web.	Flange.	Minimum rolled.	Root.	Toe.
A × B	t_1	t_2		r_1	r_2
Inches.	Inch.	Inch.	Inch.	Inch.	Inch.
3 × 1½	·20	·28	·20	·30	·15
4 × 2	·24	·31	·24	·36	·18
5 × 2½	·25	·38	·25	·42	·21
6 × 3	·25	·38	·25	·48	·24
6 × 3½	·28	·48	·28	·54	·27
7 × 3	·26	·42	·26	·48	·24
7 × 3½	·30	·50	·30	·54	·27
8 × 3	·28	·44	·28	·48	·24
8 × 3½	·32	·52	·32	·54	·27
9 × 3	·30	·44	·30	·48	·24
9 × 3½	·34	·54	·34	·54	·27
10 × 3	·32	·45	·32	·48	·24
10 × 3½	·36	·56	·36	·54	·27
12 × 3½	·35	·50	·35	·54	·27
12 × 3½	·40	·60	·40	·54	·27
12 × 4	·40	·60	·40	·60	·30
15 × 4	·41	·62	·41	·60	·30
17 × 4	·48	·68	·48	·60	·30

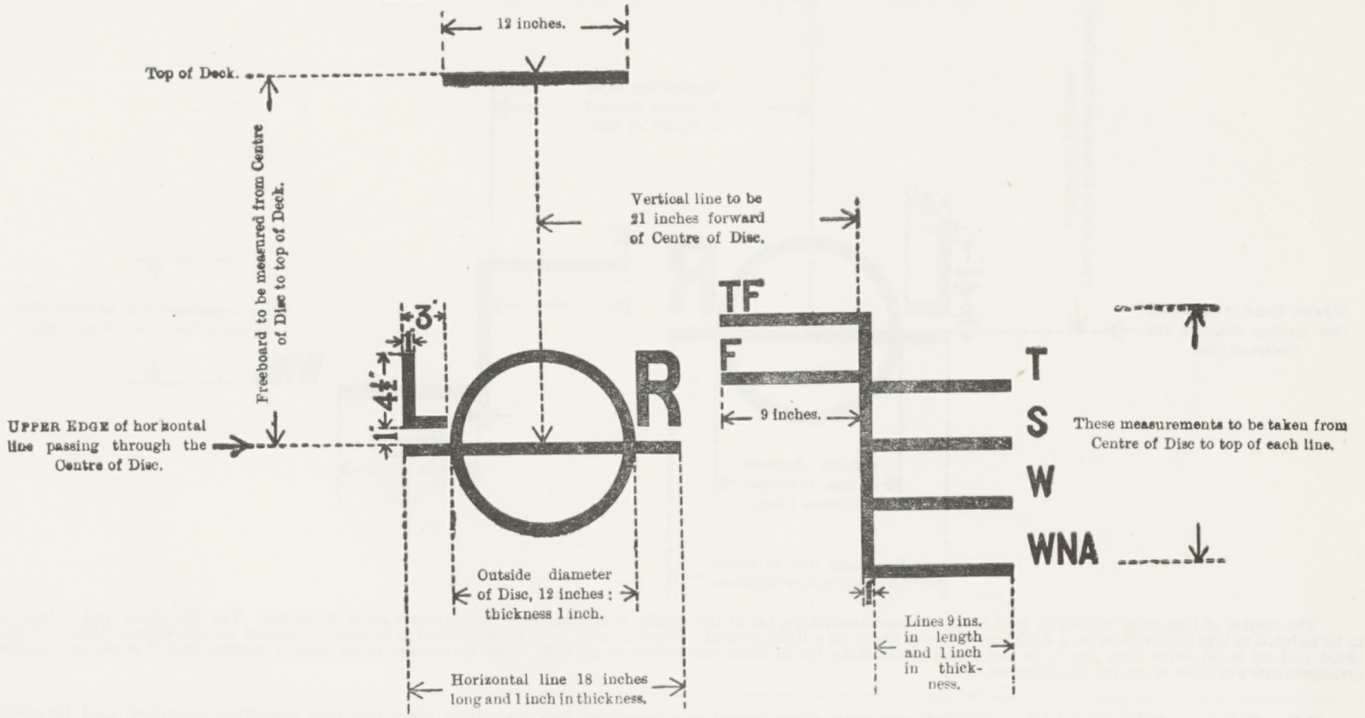
The Standard thickness of flanges of Channel bar is to be measured at distances half way between the extreme edges of the flanges and the inner side of the web.

The web of Channel bars can be increased beyond the Table thickness but the thickness of flanges remains constant.

ASSIGNMENT OF FREEBOARD.

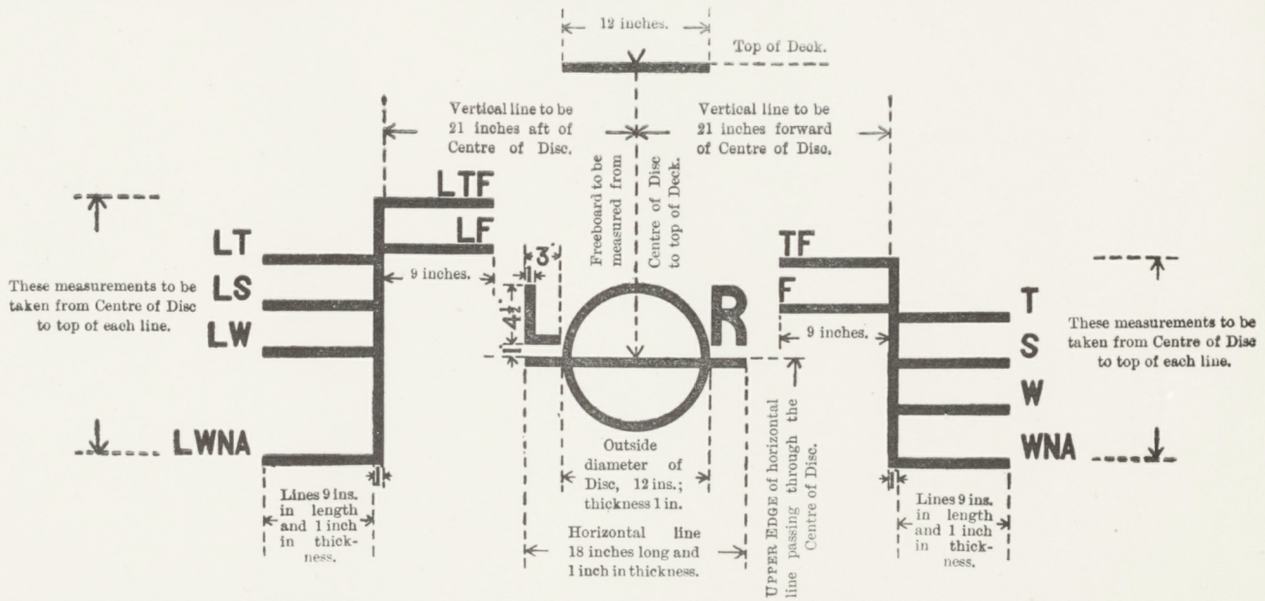
The Committee of Lloyd's Register are empowered to assign freeboards to British Vessels and to vessels registered in other countries. Forms of application for the assignment of freeboard can be obtained from the London, or other, offices of the Society.

FREEBOARD MARKING FOR STEAMERS.



The Centre of Disc to be placed on both sides of vessel amidships, *i.e.*, at the middle of the length of the Summer Load Waterline. The disc, lines and letters are to be painted in white or yellow on a dark ground or in black on a light ground. They are also to be carefully cut in or centre-punched on the sides of iron and steel ships, and on wood ships they are to be cut into the planking for at least one-eighth of an inch. The marks are to be plainly visible, and, if necessary, special arrangements are to be made for this purpose. Ships over 330 feet in length are not required to be marked with the W.N.A. line.

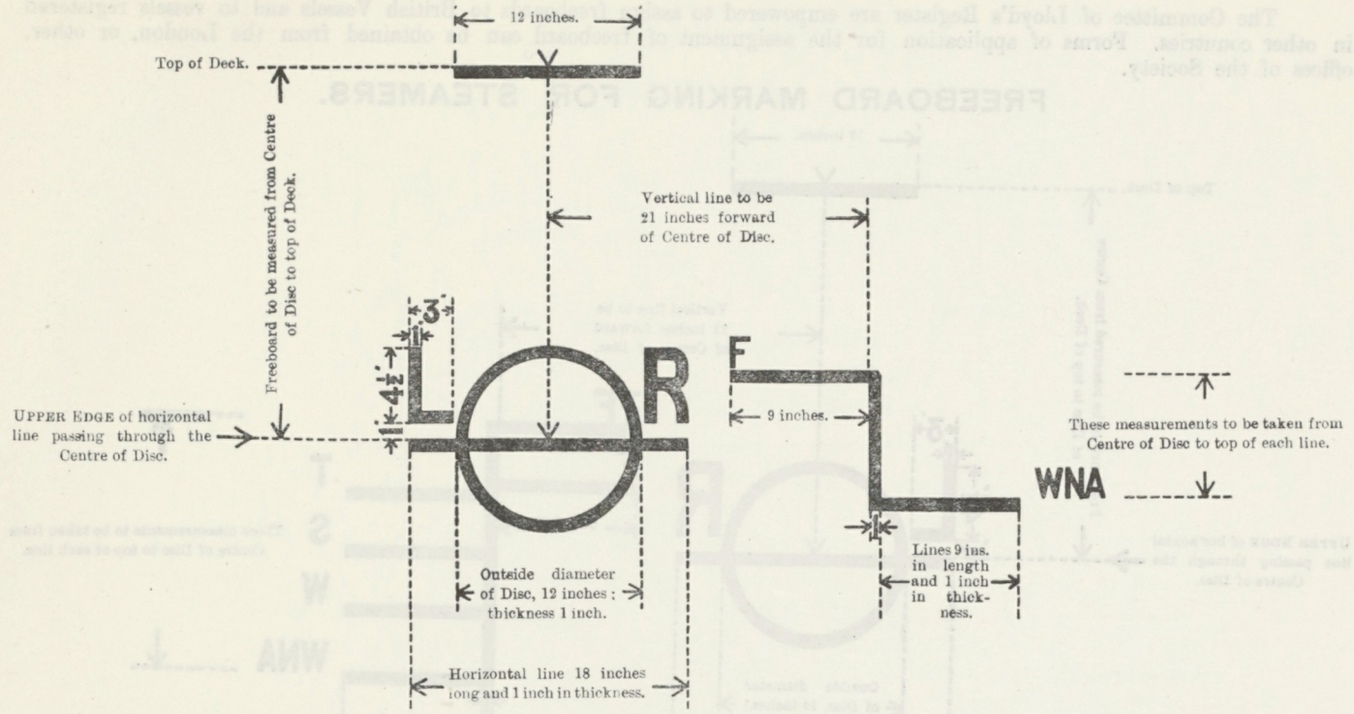
FREEBOARD MARKING FOR STEAMERS CARRYING TIMBER DECK CARGOES.



The Centre of Disc to be placed on both sides of vessel amidships, *i.e.*, at the middle of the length of the Summer Load Waterline. The disc, lines and letters are to be painted in white or yellow on a dark ground or in black on a light ground. They are also to be carefully cut in or centre-punched on the sides of iron and steel ships, and on wood ships they are to be cut into the planking for at least one-eighth of an inch. The marks are to be plainly visible, and, if necessary, special arrangements are to be made for the purpose. Ships over 330 feet in length are not required to be marked with the W.N.A. line.

N.B.—It is a condition on which a complete superstructure vessel or a vessel of less scantling than the full scantling standard and intended for other than river or inland water service is classed in the Society's Register Book that the freeboard assigned shall be marked on the vessel's sides as above prescribed. If the vessel proceed to sea with a less freeboard than that approved by the Committee, or if the freeboard mark be placed higher than the position assigned by the Committee, the vessel will be liable to have her class expunged from the Register Book.

FREEBOARD MARKING FOR SAILING SHIPS.



The Centre of Disc to be placed on both sides of vessel amidships, *i.e.*, at the middle of the length of the Summer Load Waterline. The disc, lines and letters are to be painted in white or yellow on a dark ground or in black on a light ground. They are also to be carefully cut in or centre-punched on the sides of iron and steel ships, and on wood ships they are to be cut into the planking for at least one-eighth of an inch. The marks are to be plainly visible, and, if necessary, special arrangements are to be made for this purpose.

N.B.—It is a condition on which a complete superstructure vessel or a vessel of less scantling than the full scantling standard and intended for other than river or inland water service is classed in the Society's Register Book that the freeboard assigned shall be marked on the vessel's sides as above prescribed. If the vessel proceed to sea with a less freeboard than that approved by the Committee, or if the freeboard mark be placed higher than the position assigned by the Committee, the vessel will be liable to have her class expunged from the Register Book.